BRITISH FLOWERING PLANTS

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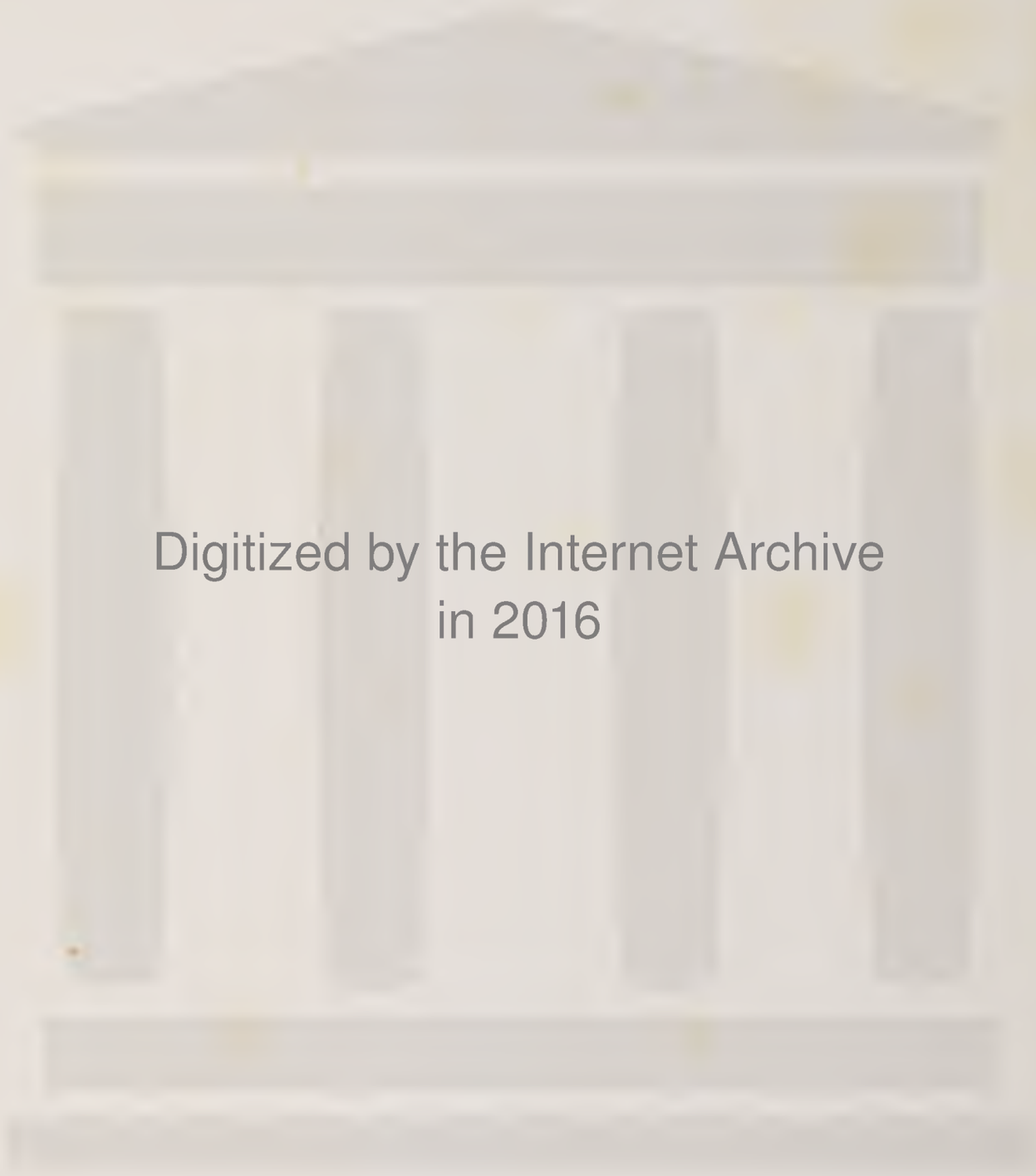
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BRITISH FLOWERING PLANTS

ILLUSTRATED BY THREE HUNDRED
FULL-PAGE COLOURED PLATES
REPRODUCED FROM DRAWINGS BY

MRS. HENRY PERRIN

WITH DETAILED DESCRIPTIVE NOTES
AND AN INTRODUCTION BY

PROFESSOR BOULGER, F.L.S.

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TO

HER ROYAL HIGHNESS

THE PRINCESS LOUISE

DUCHESS OF ARGYLL

THIS WORK IS RESPECTFULLY DEDICATED

BY

THE AUTHORS

By permission

"ART cannot add beauty to the flower; the flower is infinitely more beautiful and perfect than any representation can be; but it can make the spectator see in the flower more than he did before."

G. F. WATTS, R.A.

PREFACE

TO those who appreciate flowers they are as personal friends. Valuing them as such it is pleasant to have their portraits. When the friends are with us we can compare the likeness with the original; and when they are absent their "counterfeit presentment" forms a pleasant remembrance. The object in the water-colour drawings here reproduced has been to give faithful life-size portraits of a representative series of British wild plants. As far as possible the whole plant—root, leaf, flower, and fruit—has been included. As, in a few cases, more than one species has been drawn on one plate, 290 species, representing 248 genera, are given, and thirty analytical plates of dissections have been added to facilitate the minuter study of the plants. Of the hundred Families of British flowering plants, all but twelve are represented, those omitted, besides Grasses and Sedges, being mostly small groups of the less attractive water-plants.

The arrangement is, in the main, that of Professor Engler, now very generally admitted to be the best linear grouping as yet achieved ; and the nomenclature is in accordance with the rules of the International Congresses of Vienna (1905) and Brussels (1910). The letterpress makes no pretence to be a complete British Flora. Such an undertaking would have to be six times the size of the present work. It attempts, however, to be scientifically accurate as far as it goes, while expressed in language as little technical as possible, so as to be readily intelligible to the non-botanical reader. All technicalities employed will be found to be explained either in the Introduction, in the body of the work,

or in the Glossary at the end. The object has rather been to supply a few interesting notes descriptive of the plants delineated and their allies, with such reference as space permits to their geographical distribution, physiology, cultivation, folk-lore, and uses.

We wish to thank the many friends who have helped us, by sending specimens of some of the less common species, and by advice and criticism ; and the managers and craftsmen of the Menpes Printing and Engraving Company, for the great pains they have taken in the production of our work.

I. S. PERRIN
G. S. BOULGER

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INTRODUCTION

IT is by no means easy to generalise our ideas of a plant. The Plant World, or Vegetable Kingdom as it is more technically termed, includes not only a vast number but also a very great variety of forms, of which part only have as yet been scientifically described. Seaweeds or *Algæ*, *Fungi*, Mosses, and Ferns all come within the limits of the Vegetable Kingdom as well as Flowering Plants ; and, while the number of species, or kinds, of flowering plants has been estimated at 100,000, there are probably in the world a number of the other four groups which, taking them together, is not far short of another 100,000. We are concerned here only with the highest, *i.e.* the most highly organised, of these groups, the Flowering Plants, and of these alone there are some 1,860 species in the British Isles, if we reckon our British Hawkweeds (*Hieracium*) and Brambles (*Rubus*) at about 100 species each, and include about a score of plants which grow wild only in the Channel Islands and do not, therefore, belong geographically to the British Islands. Obviously, therefore, our drawings, representing only about 300 species, are merely a selection ; but in choosing those to be included, an endeavour has been made to render the series as representative as possible, excluding, however, as perhaps less ornamental or less suited to water-colour sketches, the Grasses, Sedges, and some minor Families of water-plants.

While some sort of grouping or classification is necessary if we are to deal intelligibly even with three hundred plants, it has been found possible by a careful scrutiny of all the external structural characters to arrange them in an order approximately *natural*, so as to express to some extent

what is apparently their *genetic affinity*, or actual relationship to one another by descent. In this study of classification it is found best to consider almost exclusively the evidence derived from the *anatomy* or structure of the plants. Groupings dependent upon *physiology* or function, such as plants that climb, plants that live as parasites, plants which form large trees, or plants which live in water, are found to afford no clue to community of origin. At the same time, though our main attention must be devoted to structure, physiological matters are of such great interest that they will often be referred to in our notes. Structure, in fact, is of little interest apart from its functions ; the mechanism apart from its application when in action.

The Parts of Plants

While the parts of a plant considered with reference to their functions are termed *organs*, it is possible also to refer them to a small number of structural types or plans of construction which are known as *members*. Almost all the structures of Flowering Plants can be considered as *roots*, *shoots*, *stems*, *leaves*, or *hairs*, whilst these primitive members are spoken of as being variously *modified*, according to the functions they have to perform. These functions fall, in the case of plants, almost entirely into two great classes, *vegetative* and *reproductive*, according as they subserve mainly the nutrition, growth, and development of the individual, or the production of seed for the perpetuation of the species. Roots, stems, and most ordinary shoots and leaves are vegetative organs; while specially modified shoots, known as *flowers*, and special parts of such shoots forming *fruits*, subserve mainly the production of seed and are, therefore, reproductive organs.

The chief characters of Flowering Plants, by which they are distinguished from lower types of existing plant life, are these more or less conspicuous flowers, and the seed to which they eventually give rise, and for these reasons Flowering Plants are technically known as *Phanerogamia* (from the Greek φανερὸς, *phaneros*, conspicuous; γάμος, *gamos*, marriage) or as *Spermatophyta* (from the Greek σπέρμα, *sperma*, a seed; φυτὰ, *phuta*, plants), as distinguished from the *Cryptogamia* (Greek κρυπτὸς, *kruptos*, hidden) or Flowerless Plants.

The seed is a relatively small structure which remains almost unchanged for some considerable time, long enough at least to bridge over the unfavourable season for plant-life above ground, whether that season be the cold and drought of winter, or the heat and drought of a dry summer season. When supplied with the requisite amount of heat, moisture, and air, the seed sprouts, and in so doing it puts out first its rudimentary root or *radicle* and then its primary shoot or *plumule*. We will, therefore, briefly consider the parts of a Flowering Plant in the order of their development in the life-cycle of a new generation : root, shoot, stem, leaves, flower, fruit, seed.

The Root

The primary root is the descending portion of the axis of the plant ; it generally has a strong tendency to grow downwards, *i.e.* towards the centre of gravity, and it bears, as a rule, neither buds nor leaves. When underground, as it generally is, it does not become green ; its growth in length takes place a little behind its apex, and this growing-point is protected by a *root-cap* of dead cells. If the radicle, or rudimentary root of a sprouting seed, grow downward with a tapering form and few if any branches, it is termed a *tap-root* and may assume various forms, such as the *conical* root of the Carrot, the *napiform* root of the Turnip (Latin *napus*, a turnip), or the spindle-shaped roots of some Radishes.

If the root branches, its branches closely resemble the main root: they force their way out through the outer tissues of the main root, being, therefore, known as *endogenous* (Greek ἔνδον, *endon*, within ; γεννάω, *gennao*, I produce) ; those first formed (*secondary roots*) being given off in regular vertical rows from the base of the parent primary root (*i.e.* its junction with the stem) towards its apex, whilst those formed later are in no regular order, or, as it is termed, *adventitious*. A much-branched tap-root, such as that of the Wallflower, or a tuft of unbranched adventitious roots, such as those of Grasses or of bulbs, are alike spoken of as *fibrous* roots. The slender branches of roots are called *rootlets*. Adventitious roots may be given off from stems, as in the Ivy and in bulbs, or from the cut ends of cuttings, or even in some cases from leaves.

The chief functions of the root are to anchor the plant in the soil, or in whatever substratum it may grow ; and to take in liquid food-material. This latter function is generally performed by minute delicate *root-hairs*, which are produced on the younger part of the roots just behind their growing region. In some cases, however, these root-hairs are absent and absorption takes place through the surface of the young root, or by means of a mass of filaments formed by a fungus which lives in a condition of partnership or *symbiosis* (Greek σὺν, *sun*, together; βίωσις, *biosis*, life) with the root. Such fungi are termed *mycorhizæ* (Greek μύκης, *mukēs*, fungus ; ῥίζα, *rhiza*, a root). In the Pea and Bean Family and some other plants tubercles are formed on the roots by bacteria, which are of service to the plant, since they are capable of absorbing the free nitrogen of the air.

In many plants, mostly biennials or perennials, *i.e.* plants taking more than a year to complete their life-cycle, the roots are enlarged so as to serve as reservoirs of nutriment for growth at a later stage. This is the case with the tap-roots of Carrot, Turnip, and Radish already mentioned, with the *tubercular* roots of the Lesser Celandine and many Orchids, the *fasciculate* or clustered roots of the Water Dropwort (*Œnanthe*), and the *nodulose* adventitious roots of Dropwort (*Spiræa Filipendula*).

Very few Flowering Plants, such as the Bladderwort, are without roots; but these and other submerged aquatic plants are capable of absorbing water from their general surfaces.

The Shoot

The plumule, or primary shoot in the seed, rises above ground in sprouting as a stem bearing leaves, growing generally upwards, away, that is, from the centre of gravity. It originates as a *bud*, or growing-point, protected by over-arching rudimentary leaves ; and as long as the stem or its branches are in an actively growing condition they are terminated by similar buds. The terminal bud of the main stem is often called *apical;* and the branching of the stems of Flowering Plants originates in the development of buds, which are generally formed in the *axil* of a leaf (Latin *axilla*, the arm-pit), *i.e.* the angle between the base of a leaf and the stem, and are, therefore, termed *axillary*. Trees and shrubs generally at the close of the season of active

growth produce special thick leathery and often brown *bud-scales* which protect the buds—thence termed *winter-buds*—during the winter. These are thrown off when the bud begins to elongate in spring, leaving crowded scars, called *ring-scars*, round the base of the next season's growth. In a variety of cases buds are capable of becoming detached and growing into new plants, a process termed *vegetative reproduction*, as distinguished from reproduction by seed. In Frog-bit and other water-plants, for instance, buds formed on lateral branches break off and sink into the mud as winter-buds or *hibernacula*, to form fresh plants in spring. Compact rudimentary buds, known as *bulbils*, are formed among the flowers of several species of Onion and become detached in a similar manner; and the short branches terminated in buds, known as *off-sets*, as in the House-leek, or the longer shoots which trail with several lateral buds from the Strawberry and are known as *runners*, by their decay detach young plants in much the same way.

There are *short shoots* which remain for a time or permanently without elongation, so that the leaves they bear are crowded together; and *long shoots* which open out and so separate their leaves. Thus the leaves of the Larch are borne in clusters on shoots which elongate after the leaves have fallen, whilst the needles of the Scots Fir are in pairs on short shoots, which do not elongate. Flowers are, in fact, also short shoots.

Many alpine and sub-alpine plants and some shore-plants, such as Primroses, Daisy, and Thrift are perennial herbaceous or slightly woody plants with a tufted mode of growth, the leaves often spreading out in a rosette.

The Stem

The *stem*, or ascending portion of the axis, differs from a root in its direction of growth, in growing at its apex, without any cap of dead tissue, in bearing buds and leaves, and in branching from its outer rather than from its inner layers of tissue. The main functions of the stem and its branches are, firstly, to convey the liquid food-material from the roots to the leaves, which have been aptly termed the laboratory of the plant, and to carry the sap elaborated in the

leaves to the various regions of the plant where growth is taking place ; secondly, to bear up and spread out the leaves so that they may obtain a suitable supply of light and air ; and, thirdly, to store up reserve food.

When the stem elongates, the regions at which leaves are given off are termed *nodes* (Latin *nodus*, a knot), and the spaces between them, *internodes*. In some cases, as in the Pink and Knot-grass Families, the nodes are swollen ; and in many quick-growing stems, such as those of Bamboos and other Grasses, and of the Carrot and Parsley Family, the internodes are hollow or *fistular*.

Stems may be developed underground or above ground. Underground stems, having no weight to support, do not require to form wood, and they are in many cases fleshy reservoirs of food, bearing leaves reduced to small membranous scales. The chief forms of underground stem are the rhizome, the corm, the tuber, and the bulb. The *rhizome*, or root-stock (often mistaken for a root but distinguished by its scale-leaves), is elongated, being made up of many internodes, generally horizontal in direction of growth, branched, and often fleshy, as in Solomon's Seal and Iris, giving off adventitious roots, chiefly from its nodes. The Water Hemlock (*Cicuta virosa*) is exceptional in having a vertical rhizome ; but there are many examples of slender ones, such as those of the Lily-of-the-valley, the Sand-sedge, and the Couch-grass. Gardeners commonly speak of propagating such plants by "dividing the root," because a portion of a rhizome bearing a bud and roots is capable of growing into a new plant. By a similar mistake the truncated appearance produced by the decay of the older part of a rhizome, as in the Primrose, has been called a *premorse root* (Latin *præmorsus*, bitten off).

The *corm* is a short, thick, solid stem, generally of a single internode, giving off roots below and bearing buds on its upper surface. The *Crocus*, Snowdrop, *Gladiolus*, and Lords-and-ladies (*Arum maculatum*) are familiar examples. The *tuber*, represented in the Potato and in the Black Bryony (*Tamus communis*), differs mainly in being made up of several internodes, so that buds or "eyes" are scattered over its

surface, whilst it bears but few roots. It is, moreover, generally a swollen branch or secondary, rather than a primary, stem. The rounded or hand-like (*palmate*) structures generally borne by our Orchids and often called tubers are mainly of root origin and have only a terminal bud. They are, therefore, preferably distinguished as *root-tubers* or *tubercles*.

The *bulb*, though resembling a corm externally, is a short conical stem of many internodes, giving off adventitious roots below, but enclosed above in a mass of overlapping fleshy leaf-scales, so that it is in fact a persistent bud. When these leaf-scales are broad so as to wrap round most of the circumference of the short stem, as in an Onion, the bulb is called *tunicate;* but when they are narrow so as merely to overlap like the tiles of a house, as in a Lily, it is termed *scaly*, *squamose*, or *imbricate* (Latin *squama*, a scale; *imbrex*, a tile). Buds originate in the axils of some of the scales and develop into fresh bulbs, known when young as *cloves*, and these become afterwards detached and thus multiply the plant.

Another method of vegetative reproduction is the formation of *suckers*, which are branches given off by a stem underground, and, after growing for some distance horizontally, rising above ground into leafy shoots and becoming capable of independent life by sending out roots from their lower parts, thus differing from runners chiefly in being partly subterranean. Many members of the Rose Family, such as the Raspberry, the Rose, and the Strawberry possess one or other of these methods of multiplication.

The *aerial* stems of plants, *i.e.* those developed above ground, may be annual or perennial in duration, branched or unbranched, woody or herbaceous. If the main stem dies within the year from the sprouting of the seed, the plant is an *annual;* but if it is only secondary branches that die down to the ground in autumn, leaving an underground stem to prolong the life of the plant, it is termed an *herbaceous perennial*. The stem may hold itself erect, either by the formation of wood or merely by its soft tissues being distended with watery contents; or it may lie prostrate on the ground, in which case its growing apex

generally takes an ascending direction; or it may climb, so as to get to light and air above surrounding plants without the necessity of great increase in size to support its increased length. Stems climb either by twining round others, as in the Bindweeds; by putting out adventitious roots, as in the Ivy; by hooked prickles, as in Roses and Brambles; by twisting their leaf-stalks round other stems, as in *Clematis;* or by special organs known as *tendrils*, which respond to contact by becoming spirally coiled. Tendrils may either be branches of the stem, as in the Grape Vine, or in other cases some part of a leaf modified for this purpose, as in Peas and Vetches.

Though usually round in section, the stem may be angular, being, for example, triangular in Sedges and square in the St. John's-worts and in the Labiate Family. As in these cases the leaves spring from the angles of the stem, the shape of the latter is closely connected with the arrangement of the former, the leaves of Sedges forming three vertical rows up the stem and those of the St. John's-worts, which are given off in pairs at each node, forming four. While young, herbaceous stems are generally green, and thus perform the same functions as the leaves; if perennial they commonly lose this colour at the close of their first year's growth owing to the formation of cork. The surface may be free from hairs and smooth or *glabrous*, as in the Spindle-tree; polished, as in Lilies; downy, as in the Hazel; or bristly, as in the Teazle. The Broom is an example of the long whip-like fluted green stem, with reduced leaves, characteristic of dry conditions.

Plants with one main woody stem ten feet or more in height are termed *trees;* those that branch freely near the ground, *shrubs;* or if less than three feet high, *undershrubs*. The stems of woody plants commonly increase in girth by the formation of an annual ring of new wood beneath their bark, so that the age of stem or branch can be told by counting the rings seen in a cross cut. The Butcher's Broom is exceptional among British woody plants in not having its wood thus arranged in rings, its structure in this respect resembling in miniature the stem of a Palm-tree.

Branches

As the branches of a stem are merely secondary stems they resemble primary stems in all particulars save in their lateral origin ; and, as they originate in the axils of leaves, their arrangement is mainly dependent upon that of the leaves, though every axillary bud does not develop into a branch. The general outline of a plant is obviously dependent upon the number, arrangement, and vigour of its branches. While, as we have said, in some plants, branches may develop into tendrils, in others they become short, rigid, pointed structures, known as *spines*, as in the Blackthorn, Gorse, and Buckthorn. Less commonly they may be flattened out into a leaf-like form, as in the Butcher's Broom, when they are known as *phylloclades* (Greek φύλλον, *phullon*, a leaf ; κλάδος, *klados*, a branch).

The Leaf

A great number of differing parts of a plant are constructed on the leaf type, or are, as is often said, modified leaves. Among them are leaves concerned in the protection or nutrition of the individual plant, and others, known as *floral leaves*, concerned directly or indirectly in seed-production ; but all alike originate in definite order on a stem from its base towards its apex, or, as it is termed, in *acropetal* succession (Greek ἄκρον, *akron*, summit ; Latin *peto*, I seek), as lateral appendages, generally differing in form from the stem that bears them. Thus in the earliest stages of the life of a flowering plant the seedling has one or two *cotyledons*, or seed-leaves, which may either remain in the seed as mere storehouses of nutriment, or may rise above ground, become green, and so serve as the first foliage-leaves. These are generally smaller and of more simple outline than the leaves developed later, as, for example, in Mustard and Cress, which are eaten as salad in this seedling stage, or in the strap-shaped cotyledons of the Sycamore.

Underground stems and the stems of many parasitic plants, such as the Broom-rapes (*Orobanche*), and *saprophytes* (Greek σαπρὸς, *sapros*, rotten ; φυτὸν, *phuton*, a plant), *i.e.* plants living upon decaying organic matter, such as dead leaves—of which the Bird's-nest Orchis is an instance—bear reduced *scale-leaves*, membranous or fleshy, and not green. Somewhat similar are the *bud-scales* that enclose the winter buds of perennial plants and are thrown

off when the buds unfold in spring, though these are generally of a more leathery texture and may contain some *chlorophyll*, or green colouring-matter. Other reduced leaves are those produced on the flowering branches or inflorescence, which bear flower-buds in their axils, and serve to protect them. These are termed *bracts;* and they vary in size, from the large sheathing ones, which enclose a whole inflorescence and are known as *spathes*, down to minute scales. The spathe of *Narcissus* is brown and membranous; that of the Lords-and-ladies (*Arum maculatum*) is green or herbaceous. A number of bracts crowded together below an inflorescence are known as an *involucre*, as in the three leaf-like bracts of *Anemone*, the whorl of brown membranous ones in *Geranium*, and the imbricate series below the flower-head of a Daisy or other member of the great Family *Compositæ*. Bracts may persist in the fruit stage, as in the cup, or *cupule*, of the Acorn, and the leafy husk of the Nut.

The usual functions of *foliage-leaves* are to *absorb* gaseous food-material, especially carbon-dioxide, from the air; to *assimilate* this material and that taken in by the roots, thus building up organic matter from inorganic materials; to *transpire* the excess of water as water-vapour, thus producing the upward flow of sap; and to *respire*, or breathe. In a few cases, such as our Sundews and Butterworts, the leaves also serve to digest and absorb the nitrogenous matter derived from captured insects: parts of leaves, or whole leaves, may be converted into *tendrils* or climbing organs; or they may become protective organs as *leaf-spines*.

Ordinary foliage-leaves, however, present so great a variety in arrangement, form, veining, surface, texture, and other characters, even among closely-related plants, that for descriptive purposes it is necessary to employ more technical terms with reference to them than to other parts of the plant. Onions, rushes, etc., have cylindric or *centric* leaves, circular in section: *Iris* and many water-side plants, liable to be occasionally submerged, are *vertical;* but most leaves are placed more or less horizontally, at right angles, that is, to the direction of the incident light, and have a contrast in structure and in colour between their upper and under surfaces. Such leaves are termed *dorsi-ventral*. A typical foliage-

leaf consists of a blade, a stalk or *petiole*, and a sheath ; but either of these may be absent, and there may or may not be in addition two lateral lobes or appendages at the base, known as *stipules*. Thus in the Yellow Vetchling (*Lathyrus Aphaca*) the blade of the leaves is replaced by a tendril, whilst its functions are performed by two large leafy stipules ; and in the related Crimson Grass Vetchling (*Lathyrus Nissolia*) the blade is also absent, but there is a long vertically-flattened petiole, known as a *phyllode*, like the leaf of a grass. Leaves with petioles are termed *petiolate ;* those without, *sessile* (Latin *sessilis*, sitting) ; those with stipules, *stipulate ;* those without, *exstipulate.* It is in but few cases that a sheath and stipules occur in the same leaf, as they do in the Rose. The various characters to be noted in describing leaves are their *vernation*, or folding in the bud ; their *position* and *arrangement* on the stem ; their *insertion*, *i.e.* the presence or absence of a petiole ; the stipules ; the *venation* or arrangement of the so-called veins ; whether they are *simple*, *i.e.* unbranched, even if deeply lobed, or *compound*, *i.e.* made up of distinctly articulated leaflets ; their *outline*, *surface*, *texture*, *colour*, and *duration.*

Vernation

In the bud the leaves of Oaks and Cherries are folded individually down their midribs, the two halves together, like those of a sheet of note-paper. This is termed *conduplicate.* The leaves of Beech and Sycamore are *plicate*, or folded like a fan, though the folds in the latter radiate with the principal veins or ribs of the leaves (*palmately*), whilst those of the former are parallel to the secondary transverse veins (*pinnately*). Plums differ from their near allies the Cherries in having their leaves rolled up in the bud from side to side, like a scroll, or *convolute :* Violets, Water-lilies, and Butterworts have both margins rolled inwards or upwards, toward the upper surface, or *involute ;* whilst Heaths, Docks, and several sand-dune grasses have them rolled backwards toward the lower surface, or *revolute.* Collectively the young leaves in a bud may be *valvate*, when they touch without overlapping, like swing-doors ; *imbricate*, when they overlap like tiles on a roof ; or *equitant*, when, as in *Iris*, each leaf is conduplicate and its two edges overlap those of the next leaf in succession, as if astride of them. This

character is called *vernation*, from the Latin *ver*, spring, the season of leaf-buds.

Position and Arrangement

In position, leaves are unhappily termed *radical* (Latin *radix*, a root), as if they sprang from the root, which they do not, when they are given off by an underground stem, as in the Primrose ; whilst those given off by aerial stems are called *cauline*. In arrangement, the most fundamental distinction is that between *scattered* leaves, which spring singly from each node of the stem, and *whorled* leaves, which are given off two or more together. In the former case many interesting variations of *phyllotaxis* or leaf-arrangement occur, according as the leaves form two, three, five, eight, thirteen, or more vertical rows up the stem. Where two leaves form a whorl, they are termed *opposite ;* and in most cases, as in the Labiate Family and most St. John's-worts, the successive pairs of leaves on a stem are at right angles to one another, or *decussate*, as it is called. Similarly, in the rare case in which three leaves form a whorl, as in Juniper, each leaf of one whorl stands over the space between two leaves of the whorl below. In many cases the actual position of the blades of leaves is altered from that indicated by their arrangement on the stem by a twist in the petiole, so that the blades form a pattern or *leaf-mosaic*, with little or no overlapping. The rationale of leaf-arrangement is to secure the maximum of light and air.

Venation

Among the distinctive characters of the main divisions of Flowering Plants few are of more importance than the *venation* or arrangement of the so-called veins, ribs, or nerves of the leaf, those conspicuous lines of vessels which convey food-materials from the roots, and elaborated sap back to the body of the plant, and which remain as a skeleton when the cellular tissue of the leaf perishes. One main type is *parallel-veined*, as in Lilies, Orchids, Grasses, etc., in which the principal veins, after diverging at the base of the leaf, run approximately parallel and generally converge once more at the apex ; while cross-veins are much finer and less conspicuous, and form with the longitudinal ones an almost rectangular mesh-work. The other main type, known as *reticulate* or *net-veined*, may have either one principal vein or

midrib, from which slightly finer transverse secondary veins are given off, like the barbs of a feather, whence it is called *pinnate*, or several principal veins radiating from the base of the leaf, like the fingers from the hand, whence the name *digitate* or *palmate ;* but in either case, as is well seen in the leaf of a Primrose or a Sycamore, the finer ultimate branch-veins run together at various angles, making a complex and seemingly irregular mesh. It will be noticed that the venation largely influences the incision of the margin or the branching of leaves.

Composition

No matter how deeply the margin of a leaf may be cut, as in the leaves of Buttercups or Dandelions, if the leaf be not divided into distinct leaflets, separately articulated to the petiole or midrib, it is termed *simple*, while according to its venation it may be *pinnately-lobed*, as in the Dandelion, or *palmately-lobed*, as in Buttercups or Sycamore. A *compound* leaf is made up of distinct leaflets and must be carefully distinguished from a stem bearing leaves. Unlike a stem, it has no growing point, and its leaflets do not bear buds in their axils. It may be either *palmate*, when the leaflets radiate from the apex of the petiole, or *pinnate*, when they are given off from its prolongation the midrib or primary *rhachis*. Special terms are sometimes used for the *ternate* leaf, or palmate leaf of three leaflets in Clover or Wood-sorrel ; the *quinate* leaf, with five leaflets in Cinquefoil ; or that with seven in the Horse-chestnut. If the petiole branches palmately once or twice, only the ultimate branchings ending in leaflets, it is termed *bi-* or *tri-palmate*. The leaf of Baneberry is, for example, *tri-ternate*. The leaflets of pinnate leaves are generally in opposite pairs, each pair being termed a *jugum*, and the number of juga ranges from one to a large number (*multi-jugate*), as in some Vetches, while alternate juga may be large and small, as in Agrimony, when it is called *interruptedly pinnate*. There is generally a terminal leaflet, as in the tri-jugate leaf of the Rose, which is, therefore, termed *impari-pinnate*, or unequally pinnate, though the leaf may, as in the False Acacia, be *paripinnate*, or equally pinnate, *i.e.* with no terminal leaflet. The leaflets of a pinnate leaf are termed *pinnæ ;* but if they are themselves branched pinnately the leaf is *bi-* or *tri-pinnate*, its divisions are known as primary

or secondary pinnæ, or the ultimate divisions are termed *pinnules*. If, however, a leaf be cut up into innumerable very fine segments, as in the Carrot, Fennel, Water-crowfoot, and some other submerged plants, it is termed *decompound*.

Margin

If the margin of a leaf is free from any indentations, as in the Lily-of-the-valley, it is termed *entire ;* if wavy, as in the Oak, *sinuate ;* if scalloped, with rounded scallopings, as in the Violet, *crenate ;* if toothed with teeth pointing outwards, *dentate ;* if pointing backwards towards its base, as in the Dandelion, *runcinate ;* or if, as is much more frequent, pointing upwards, *serrate*. It will be noticed that the serrations may be even, as in the Rose and the Linden, or irregular, as in the Hazel, or may be themselves once or twice toothed (*bi-* or *tri-serrate*), as in " cut-leaved " varieties of many trees.

Base

Among descriptive terms applied to the base of the leaf the more important are *cuneate* or wedge-shaped, as in the Plane ; *attenuate*, with the blade tapering down along the stalk, as in the Daisy ; and *cordate* or heart-shaped, as in the Water-lilies. The projecting lobes at the base of the blade in such leaves as these last are called *auricles* (Latin *auricula*, a little ear), and these auricles are often unequal in size, the one towards the centre of the bud having less room to develop. This produces the *oblique* base seen in the Linden, Elm, and Hazel, and, among cultivated plants, in Begonia. If a sessile leaf is cordate, it is sometimes termed *auriculate*, whilst if its auricles, owing to more luxuriant growth, overlap one another, the leaf is called *amplexicaul* (Latin *amplexus*, embraced ; *caulis*, stem). If the auricles grow together, so that the stem appears to be growing through the leaf, the latter is, somewhat absurdly, called *perfoliate*, and a little-known group of plants, the Hare's-ears (*Bupleurum*), derive from this character their Old English name of Thorow-wax. If the auricles adhere to the stem below the base of the leaf, as in most Thistles, the leaf is termed *decurrent*. Pointed auricles extending downwards make the leaf *sagittate*, or arrow-shaped, as in the beautiful water-plant called for this reason Arrow-head ; whilst if they point outward, as in some Docks,

the leaf is called *hastate*, or halberd-shaped. It is practically by a growing together, or simultaneous expansion, of the auricles of rounded petiolate leaves that the striking shield-shaped, or *peltate*, leaves (Latin *peltis*, a shield) of the plants known in consequence as Pennyworts are produced, in which the stalk springs apparently from the centre of the under surface.

Outline

Of the large number of terms by which botanists endeavour to express definitely and concisely the wellnigh infinite variety of the general outline of leaves, *i.e.* the relations of their margins, the following are the chief. With straight, parallel sides, leaves may be *acicular*, or needle-shaped, as in Pines, when they are generally many times longer than they are broad, but not much broader than they are thick, and are hence prismatic in cross-section ; *linear*, with some appreciable width, but at least four times as long as they are broad, as in Lavender, *Iris*, and Grasses ; or *oblong*, not more than four times as long as they are broad, as in the floating leaves of some Pond-weeds. With rounded sides and widest across the middle, leaves may be *oval*, if more than twice as long as they are broad, as in the Butterworts ; *elliptical*, if less than twice as long as they are broad, as in the Apple ; or *round* or *orbicular*, as in the Water-lilies and Pennyworts. If widest near their base, leaves may be *lanceolate*, if at least four times as long as they are broad, as in the Creeping Willow (*Salix repens*) and some other species of the genus *Salix ; ovate*, if little more than twice as long as they are broad, as in the Pear ; or *reniform*, or kidney-shaped, broader than they are long, as in Ground-ivy (*Nepeta hederacea*). If widest near the apex, leaves may be *spathulate* or spoon-shaped, rounded above and attenuate at the base, as in the Daisy ; *ob-lanceolate*, *i.e.* reversedly lanceolate and, therefore, at least four times as long as they are broad, as in the Ribwort Plantain ; or *ob-ovate*, similarly not much more than twice as long as they are broad, as in the Cowslip. *Deltoid* leaves, such as those of the Danish Scurvy-grass (*Cochlearia danica*), approximate to an equilateral triangle ; while the term *triangular* is applied to such longer or isosceles forms as those of the

Arrow-head ; and in Birch and Poplars we have examples of *rhomboid* leaves, approximately four-sided, with acute angles at the base and apex and obtuse ones at the sides. Even with all this terminology many intermediate forms are found, for which we have to combine two terms, *ovate-lanceolate*, for instance, being a very frequent outline. There is always a considerable range of variation in the leaves of any one plant ; and when cauline and radical leaves occur on the same plant, as in the Shepherd's-purse, they generally differ considerably in form ; but the term *heterophyllous* is specially applied to plants, like some of the Water-crowfoots, the Arrow-head, and others, in which two or more markedly different types of leaf, such as broad floating ones and decompound or narrow ribbon-like submerged ones, occur on the same plant.

Apex

The apex of a leaf may be rounded or *obtuse*, as in the Oak ; *acute*, as in the Rose ; *acuminate*, or narrowing suddenly into a long tapering point, as in Nettles ; or *ob-cordate*, reversedly heart-shaped, as in the leaflets of the Wood-sorrel. In describing compound leaves, the leaflets, after their number and arrangement have been mentioned, are treated as simple leaves would be.

Surface

The surface of the leaf is described by the same terms as are used for herbaceous stems. It may be *glabrous*, or free from hairs, as in the Spindle-tree ; *glabrescent*, or hairy when young, becoming smooth later, as in the Beech ; *pubescent* or downy, with numerous short hairs, as in Sage ; or *silky*, with long hairs, as in the under surface of the leaves of the Alpine Lady's-mantle. Careful note should always be taken of the hairs on plant-surfaces, whether they are in lines, or confined to the margin of the leaf or the forkings of its veins, to its under or upper surface ; whether they lie flat or *adpressed* to the surface, or spread outwards ; whether they are *stellate* or star-shaped, or tipped with rounded *glandular* ends. One very striking character of surface is the blue-grey, or *glaucous*, coating of minute wax-particles characteristic of a large number of sea-shore plants, such as Cabbages, Sea-Kale, Sea-Poppy, Sea-Holly, Carnations, etc.

Exceptional textures of leaves worthy of notice are the *leathery* character of most evergreens, such as Holly, Ivy, Yew, and Heaths ; and the thick *fleshy* character of those of plants distinctive of dry situations. Such are the House-leek and Stone-crops, growing on walls, and many plants of the sea-shore, where, though water is abundant, its salt renders it useless for plant-nutrition.

Texture

The most striking colour characters among our British plants, in addition to the glaucous surface of sea-side plants just mentioned, are the dark green of the upper surfaces of most evergreens ; such snowy whiteness as the downy under surface of the leaves of the White-beam ; and the remarkable and unexplained purplish blotches on the leaves of Lords-and-ladies and some of our commoner Orchids.

Colour

Lastly, in duration, we have every gradation, from the short-lived leaves of such annuals as Chickweed, which pass through their whole life-cycle in a few weeks, to the ordinary *deciduous* leaves of most of our northern trees, produced in spring and falling in autumn, such *sub-evergreen* leaves as those of Privet, which survive a mild winter, and true *evergreens*, which habitually remain on the tree until after a fresh crop has unfolded, as in Holly and Ivy. The needles of Pines and Cedars remain on for several years.

Duration

Passing from those structures that are, as we have seen, mainly concerned with the nutrition of the individual to those connected with the production of seed, we find that these last are constructed on the same types or plans of stem, leaf, or hair as are those already described. The special region of the plant or system of branches which bears the flowers is termed the *inflorescence*. If it springs direct from an underground stem, it is termed a *scape ;* and a scape may be one-flowered, as in the Tulip or Anemone, or many-flowered, as in the Cowslip, Lily-of-the-valley, and Daisy.

The Inflorescence

Inflorescences of more than one flower are divided according to the order of development of their flower-buds and branches into three groups—*racemose* or *indefinite*, *cymose* or *definite*, and *mixed*. In the racemose type

there is one main axis or peduncle which bears lateral flowers or branches in succession from below upwards, the terminal or central flower being the last formed. As this axis may be either elongated or arrested, and the flowers may be either sessile or stalked, this gives us four main types—the *spike*, the *raceme*, the *head* or *capitulum*, and the *umbel*. The *spike* has an elongate axis and sessile flowers, as in most of our Orchids, though the green ovary below their flowers is often mistaken for a flower-stalk. The *raceme* has an elongate axis with stalked flowers, as in the Wild Hyacinth or Shepherd's-purse. If the stalks of the lower flowers are longer so as to bring all the flowers nearly to a level and thus render them collectively more conspicuous, as in the Wallflower, it is termed a *corymbose raceme*. The *head* or *capitulum* has numerous sessile flowers, called *florets*, on account of their small size, crowded together on the expanded apex of the arrested axis or peduncle, as in Scabious and in all the great Family *Compositæ*, such as Daisies, Thistles, and Dandelions. This inflorescence is commonly mistaken for a flower. The *umbel* has the main axis arrested but its flowers stalked, all the stalks radiating from a common centre, like the ribs of an umbrella, as in the Ivy.

If an inflorescence is only once branched, as in the examples above cited, it is termed *simple;* if more than once, *compound*. Thus in Wheat we have a *compound spike*, or *spike of spikelets;* and in the Hemlocks and most other members of the Family *Umbelliferæ*, a *compound umbel* or *umbel of umbels*.

In *cymose* or *definite* inflorescences, or *cymes* as they are termed collectively, the main axis terminates in a flower which is the first to open, secondary axes or branches being given off below it. Thus this first flower is terminal, or, in crowded inflorescences, central. If, as is often the case where the leaves are in opposite pairs, as in St. John's-worts and Stitchworts, two branches originate below the terminal flower, each ending in a flower below which more branches originate, and so on, we have a *bilateral cyme;* but there are many other cases where the branching is *unilateral* and extremely complex. Where the flowers are crowded and nearly sessile, the centre one opening first, as in the wild Deptford Pink

and the Sweet Williams of our gardens, the cymes are termed *fascicles;* but if such a cluster occurs in the axil of a leaf, as in the Box, it is called a *glomerule;* and two such glomerules in the axils of two opposite leaves, as in the Dead-nettles, form a *verticillaster*, or false whorl round the stem. Other forms of cyme are named from the indefinite inflorescences which they resemble, often very closely. Thus the Guelder-Roses have *corymbose cymes*, Stone-crop has a *spicate cyme*, and Cranes'-bills have *umbellate cymes*. *Mixed* inflorescences are those in which the first order of branching may be racemose and the second cymose, or *vice versa*. Thus the Purple Loosestrife and the Spearmint have a *spike of verticillasters*, the Chicory has a unilateral *cyme of capitula*, and the Ragwort a *corymbose cyme of capitula*.

The Flower

The flower is a shoot or branch bearing leaves modified so as to assist directly or indirectly in the production of seed. The internodes, or joints of the stem between the leaves, are seldom at all elongated, so that the leaves are crowded together, either spirally or in whorls; and the floral leaves (which do not produce buds in their axils) are of four kinds, known respectively as *sepals*, *petals*, *stamens*, and *carpels*. These, though not necessarily all present in every flower, are, if present, always in this order on the axis from below upwards. The portion of the axis within the flower is known as the *receptacle* or *thalamus*. The sepals collectively constitute the *calyx* (Greek κάλυξ, *kalux*, a cup); the petals, the *corolla* (Latin for a little crown). Calyx and corolla together are termed the *perianth* (Greek περὶ, *peri-*, round; ἄνθος, *anthos*, a flower) or *floral envelopes*, in contradistinction to the stamens and carpels, which are called the *essential organs*, since seed cannot be formed if they are absent. If both calyx and corolla are present in the same flower, as in the Buttercup, in which flower the five sepals are green and the petals golden, the flower is termed *complete;* but if one or both of these envelopes is absent, the flower is *incomplete*. An incomplete flower, if it has one envelope, as in the Marsh Marigold, is *monochlamydeous* (Greek μόνος, *monos*, one; χλαμὺς, *chlamus*, a cloak), while if it has neither calyx nor corolla, as in the Ash, it is *achlamydeous* (Greek ἀ, *a-*, without; χλαμὺς, *chlamus*, a cloak). If both

stamens and carpels are present in the same flower, it is *perfect;* if only one class of these essential organs is present, the flower is *imperfect*, and *staminate* or *carpellate*, as the case may be. Plants with imperfect flowers may be either *monœcious* (Greek μόνος, *monos*, one ; οἶκος, *oikos*, a house), where, as in the Scots Pine and the Oak, staminate and carpellate flowers occur on the same plant ; or *diœcious* (Greek δι, *di-*, two), where they are on distinct individuals, as in the Willows and Poplars. In the few cases in which neither stamens nor carpels are present, as in the outer florets of the blue Cornflower, or the outer flowers in the cluster of the Guelder-Rose, the flower is termed *neuter*. In a wild state, all the flowers of a plant are probably never neuter; but they are so in the Snowball-tree, a cultivated form of the Guelder-Rose.

Some plants, in addition to their more conspicuous flowers, produce, generally later in the season, others which never open, but, though remaining bud-like, produce abundant fertile seed. Such flowers occur in the Sweet Violet and Wood-sorrel, and are known as *cleistogene* (Greek κλειστὸς, *kleistos*, closed ; γένος, *genos*, birth).

In perfect flowers the stamens and carpels may reach maturity simultaneously, that is to say, the stamens may be ready to burst and discharge their pollen whilst the carpels are in a receptive condition, so that self-pollination is at least possible. This is commonly the case in small inconspicuous flowers and is termed *homogamy* (Greek ὁμὸς, *homos*, alike ; γάμος, *gamos*, marriage). In other cases the stamens and carpels mature at different times, or are *dichogamous* (Greek διχῶς, *dichos*, apart) :—either, as is more commonly the case, the stamens maturing before the carpels, when the flower is called *protandrous* (Greek πρῶτος, *protos*, first ; ἀνδρὸς, *andros*, of a man) ; or the carpels before the stamens. This latter is termed *protogyny* (Greek πρῶτος, *protos*, first ; γυνὴ, *gune*, a woman), and, for some unexplained reason, occurs generally in plants in which the pollen is carried from plant to plant by wind, as in the Plantains. If plants are completely dichogamous it is obvious that they cannot be self-pollinating.

In what appear to be primitive types of flower, as in the little Mouse-tail (*Myosurus*), a member of the Buttercup Family, the floral receptacle is

commonly elongated, the floral leaves, or some of them, being given off from it in a spiral. In higher types the development of the axis is arrested and the floral leaves become whorled. The number of whorls is typically five, and there are commonly either five or three leaves in each whorl, though many modified arrangements occur. Thus, whilst the Stone-crop has five sepals, five petals, ten stamens, and five carpels, and the Wild Hyacinth three outer and three inner perianth-leaves, six stamens, and three carpels, an indefinite number of stamens is common, as in the Buttercup and the Rose; five occur in many plants; the carpels may be indefinite in number, as in the Mousetail, the Buttercup, and the Rose, or are commonly reduced in number to three, as in the Violets; two, as in Nightshade; or one, as in Plums and in the Pea Family. In the Enchanter's Nightshade (*Circæa*) there are four whorls of two leaves each, *i.e.* two sepals, two petals, two stamens, and two carpels.

As a rule, the leaves of each whorl are alternate with those of the preceding whorl, the petals being opposite the spaces between the sepals and the outer row of stamens opposite the spaces between the petals. Primroses and Irises are marked exceptions to this rule, the five stamens of the former being opposite to or *superposed* to the petals, and the three carpels of the latter superposed to the three stamens. Such exceptional cases may generally be explained by a whorl of stamens having become suppressed.

Where the floral leaves in each whorl are similar in size and shape, the flower can be divided symmetrically in several directions or planes intersecting in its centre, and is termed *polysymmetric*. Where the floral leaves are so unequal that, as in a Pea or Orchid, the flower can only be so divided in one direction, it is *monosymmetric;* whilst when it cannot be symmetrically divided in any direction, as in the Valerians, it is *asymmetric*.

Insertion

The arrangement of the floral leaves upon the floral receptacle, and the modification of the latter, produce differences in what is called the *insertion* of the parts of the flower which are very important in the Natural System of classification. If sepals, petals, stamens, and carpels spring one beneath the other from such a more or less conical receptacle, as in the Mousetail, Buttercup, or allied plants, the calyx is

inferior, the corolla and stamens are *hypogynous* (Greek ὑπὸ, *hupo*, under ; γυνὴ, *gune*, a woman), the carpels are *superior*, and the flower as a whole is called *thalamifloral*. If, as in the Bramble or the Strawberry, the calyx, corolla, and stamens are carried out from under the carpels by a horizontal disk-like extension of the receptacle, or if, as in the Plums or the Roses, sepals, petals, and stamens are carried up on a tube-like expansion of the receptacle which does not adhere to the sides of the carpels, the calyx is still termed inferior and the carpels superior, the petals and stamens being *perigynous* (Greek περὶ, *peri-*, round ; γυνὴ, *gune*, a woman). If, as in the Apple, the Pear, and the Hawthorn, this receptacular tube does adhere to the sides of the carpels, the calyx becomes *superior*, and the *ovary* formed by the carpels is *inferior*, petals and stamens being still perigynous. If, lastly, as in the Families *Compositæ* and *Umbelliferæ*, this adherent tube carries the sepals, petals, and stamens on to the top of the ovary, the calyx is superior, the ovary inferior, and the petals and stamens *epigynous* (Greek ἐπὶ, *epi-*, upon). When petals and stamens are perigynous or epigynous the flower is sometimes called *calycifloral*, from the mistaken interpretation of the structure as being a springing of petals and stamens from the calyx. This error is also perpetuated in calling the receptacular tube, which carries up sepals, petals, and stamens alike, a "calyx-tube."

Calyx

The calyx is usually green, though it may, as in the Marsh Marigold or Anemones, be *petaloid*, *i.e.* of some other colour and resembling the petals in texture. Its sepals are commonly five, four, three, or two in number, broad at the base, pointed above, simple in outline, and may be either *free* or *polysepalous* on the one hand or united (*gamosepalous*) on the other. In all hypogynous flowers the calyx, as we have seen, will be *inferior*, and in all epigynous flowers, *superior*, these terms implying the absence or presence of "adhesion" between calyx and ovary rather than mere lower or higher position. The direction of growth of the sepals is often an important distinctive character. They are, for instance, *erect* in the Cabbages, but *ascending*, growing upwards and outwards, in the closely-related Mustards, *spreading* or horizontal in the Common Buttercup, and *reflexed* in the Bulbous Buttercup. Individual sepals may be *pouched* at the base to receive nectar secreted by other parts, as in the Wallflower, or prolonged into a tubular *spur*, as in the Larkspur. Want of symmetry

is, however, less common in the calyx than in the corolla ; but a frequent form in specialised, insect-pollinated, horizontal flowers is the *bi-labiate* or two-lipped, in which five sepals, united into a tube below, are divided by deep notches or *sinuses* into two groups of two and three respectively. In Gorse and Broom, for instance, two sepals form the *posterior* or upper lip and three the *anterior* or lower, though the sinuses between each sepal are often indistinct. In the Sage and Mint Family, which are known technically as *Labiatæ* (*i.e.* lipped), there are, however, three sepals in the posterior and two in the anterior lip. Polysymmetric gamosepalous forms of calyx include the *tubular*, as in Centaury ; the tubular and *plaited*, *i.e.* folded so as to be star-shaped if cut across, as in the Primrose ; the wider *cylindric*, as in the Cheddar Pink ; the bell shaped or *campanulate*, as in Henbane ; and the barrel-shaped or *urceolate*, as in the Sea-Campion. In this latter and some other cases the calyx is termed *inflated*, because there is a space between it and the corolla, an adaptation apparently to prevent the illicit stealing of the honey in the corolla-tube by insects boring through the wall of the calyx-tube. In some of the Family *Compositæ*, and in some other flowers, the upper free portion or *limb* of a gamosepalous calyx is replaced by a circlet of hairs known as a *pappus*, which develop chiefly in the fruit stage. In the Dandelion this pappus is *stipitate* or stalked, being carried up on a slender calyx-tube, while in the Thistles it is sessile. The hairs of the pappus of the Dandelion are unbranched or *pilose ;* those of the Thistles are feathery or *plumose*. In duration the sepals may be *caducous*, falling off as the flower opens, as in Poppies ; *deciduous*, falling with the petals and stamens after fertilisation, as in the Cherry or Plum ; or *persistent*, remaining in the fruit stage, as in the Strawberry. When persistent, they are often *marcescent* or withered, as in the Apple and the Gooseberry.

Corolla

Whilst the calyx is commonly green, often hairy externally, as a protection against small crawling insects that might steal the honey without effecting cross-pollination, and generally protective in function, the corolla is more often delicate in texture, brightly and conspicuously coloured and scented, serving the special purpose of attracting flying insects. Its petals are commonly attached by a narrow base, sometimes drawn out into a long narrow portion, known as the *claw*, as in Wallflower or Campion ; and they are generally rounded,

though they may be notched more or less deeply, as in the Rose, which is termed *emarginate*, or the Chickweed, which is *bi-fid*, *fringed*, as in Pinks, or deeply *multi-fid*, as in Mignonette, or cut up in a branching manner, or *laciniate*, as in Ragged Robin. "Double" flowers, with more than one whorl of petals, are rare in a wild state; and three, four, or five are the most usual numbers. The presence or absence of *cohesion* between the petals, whether, that is, they are *polypetalous* or *gamopetalous*, is an important character in classification; as is also their insertion, whether *hypogynous*, *perigynous*, or *epigynous*; and their symmetry.

The chief polypetalous forms demanding separate consideration are the *cruciform*, characteristic of the Family *Cruciferæ*, which includes Wallflower, Mustards and Cresses, in which there are four equal petals placed cross-wise, or, as it is put technically, in the diagonal planes, in one whorl; and the *papilionaceous* (Latin *papilio*, a butterfly), characteristic of all the British representatives of the Pea and Bean Family (*Leguminosæ*), in which there are five petals, the posterior one—that nearest the stem—called the *standard* and usually the largest and most erect, two side ones called *wings*, and two lower or anterior, often slightly united, known as the *keel*, the whole corolla being thus monosymmetric, or divisible symmetrically only along one plane, that known as the *median plane*, extending from the back to the front of the flower.

Among gamopetalous corollas the chief polysymmetric forms are the *tubular*, as in the florets of Thistles; the wider *bell-shaped* or *campanulate*, as in the genus *Campanula*, including the Hare-bell; the *urceolate*, or barrel-shaped, narrowing at the mouth, as in many Heaths and Whortleberries; the *funnel-shaped*, narrow at the base and widening outwards, as in the small Field Convolvulus; the *trumpet-shaped*, with reflexed margins, as in the large Hedge Convolvulus; the *salver-shaped*, with long tube and limb at right angles to it, as in the Primrose; and the *rotate* or wheel-shaped, with short tube, as in the Pimpernels and Forget-me-not. The chief monosymmetric gamopetalous forms are the bi-labiate and the ligulate. The *bi-labiate* or two-lipped corolla has generally two posterior petals united to form the hood and three anterior ones united into a

landing-place for insect visitors or *labellum* (Latin, a little lip). Honeysuckle is exceptional in having four reflexed posterior petals and a single one reflexed as a labellum. Bi-labiate corollas may be either *ringent* or gaping, as in the Dead-nettles and most of the Family *Labiatæ ;* or *personate*, *i.e.* mask-like, as in the Snapdragon, in which the two lips are closely pressed together, so as to require to be forced apart by the insect. Whilst the Snapdragons have a honey-pouch at the base of the corolla-tube, the Toad-flaxes have a spur. The *ligulate* or strap-shaped corolla is characteristic of the outer or "ray" florets of such *Compositæ* as the Daisy or the Ragwort and of all the florets in the Sub-Family *Liguliflorœ*, such as the Dandelion. It has five petals, united in a tube below, some of which expand as a strap-shaped limb notched at its apex so as to suggest the number of petals so developed.

The colours of the petals are connected with their perfumes and with the visits of insects. Petals are supposed to be derived from the degeneration of stamens ; and to have been, in primitive types of flower, yellow or white. Many white flowers are sweet-scented and are pollinated by night-flying moths ; whilst bees show a preference for blue flowers, which are less common ; and wasps, for orange or dark red or brown flowers. Many weeds of world-wide distribution, on the other hand, have small scentless white blossoms, are seldom visited by insects, and produce abundance of seed as the result of self-pollination. Lines of dots on the petals, as in the Pinks, or dark lines, as in the Common Mallow, are "honey-guides," directing the insect visitors to the particular part of the flower at which nectar is secreted.

In duration, the corolla may be *fugacious*, falling, that is, directly the flower is gathered, as in the Flaxes ; *deciduous*, falling after pollination, as is usually the case ; or *persistent*, as in *Campanula*, in which case it remains in a shrivelled state round the fruit.

Æstivation (Latin *æstivus*, belonging to summer), the folding of the floral envelopes in the flower-bud, is often characteristic of Families and is described mainly as in the vernation of the leaf-bud. In *Clematis* the sepals are *valvate*, touching at their edges without overlapping ; whilst in

the rest of the Buttercup Family they are *imbricate*, overlapping like tiles on a roof. Poppies have their petals *crumpled*. The Mallow Family have the sepals valvate and the petals *convolute*, that is, with one edge towards the centre of the flower, and the other rolled round the next petal. In *Convolvulus* the coherent petals are convolute but also twisted upwards, or *contorted*.

Stamens

The stamens vary greatly in number, from one in Lords-and-ladies, Spurge, and Spur-Valerian, two in *Veronica* and some Willows, three in *Iris*, four in Ladies-mantle, five in *Umbelliferæ*, or six in Lilies, up to an indefinite number in Buttercups; and they may be arranged spirally or in one, two, or more whorls. Each stamen consists typically of a slender stalk or *filament* surmounted by the *anther*, an oblong or rounded body, generally two-lobed externally and, when ripe, two-chambered internally, which bursts and discharges the *pollen*. This usually occurs as a fine yellow dust, which, carried by wind or insects from one flower to another, is the active or male element in fertilisation or "setting seed."

The stamens are commonly in one or two whorls and are accordingly either equal in number to, or double the number of, the petals; but in some large groups of plants one or more stamens of such normal number are undeveloped or *suppressed*, or are imperfectly developed or *aborted*, producing no pollen. These last are termed *staminodes*. In other cases, such as the St. John's-worts, the stamens branch, each bearing several anthers. These are termed *polyadelphous* (Greek πολὺς, *polus*, many; ἀδελφὸς, *adelphos*, a brother). A tubular outgrowth from the receptacle may carry up all the stamens, as in the Mallows and in Gorse, when they are called *monadelphous;* or they may be united in two sets, or *diadelphous*, as in most of the Pea and Bean Family, in which nine are so united and one—the upper one—is separate; or they may be united by their anthers, as in the Family *Compositæ*, when they are termed *syngenesious* (Greek σὺν, *sun*, together; γένεσις, *genesis*, beginning). In insertion they are, like the petals, hypogynous, perigynous, or epigynous; but they may be united on a common tube with the petals, or *epipetalous*, as in the

Primrose, or adherent to the carpels in a central *column*, as in Orchids. The stamens are commonly equal in length ; but if in two circles, as in the Purple Loosestrife, these circles are often of different length ; and in the Family *Labiatæ*, the Mint and Thyme group, there are four stamens developed, two longer than the other two, or *didynamous* (Greek δι-, *di-*, two ; δύναμις, *dunamis*, strength), whilst in the *Cruciferæ*, or Wallflower Family, there are six, four—or more truly two deeply bifurcate ones—long and two short (*tetradynamous*). The various forms of the filaments and of the anthers, the attachment of one to the other, and the ways and direction in which the anthers split when ripe, are also characters of importance in discriminating groups.

The pollen is usually abundant and in very minute, smooth, round, dry granules in those less conspicuous flowers, such as those of grasses and catkin-bearing trees, in which it is carried by wind ; and scantier and in somewhat larger granules of various forms, with projecting points or ridges, waxy and coherent, in those flowers which are visited by insects.

Carpels

The *carpels* occupy the centre of the flower. There may be only one, as in Peas, Beans, Cherries, etc. (*monocarpellary*), or any other number (*polycarpellary*), often two, three, or, if arranged spirally, as in a Buttercup, a much larger number. When more than one, the carpels may be free from one another (*apocarpous*), as in the flower just mentioned, or united (*syncarpous*), as in a Lily, an Orchid, or a Violet. In either case, the carpel, which is essentially a leaf, consists typically of three regions—the broad basal portion, which forms, or contributes to form, the *ovary;* a narrower, tubular portion, or *style;* and the sticky extremity, or *stigma*, which receives the pollen carried by wind, insects, or other means. When the carpels are apocarpous, as in the Columbine or Strawberry, each forms a distinct ovary, style, and stigma ; whilst when there is only one carpel, as in the Pea, it is easy to trace the midrib and lateral veins of the carpellary leaf, and to realise that the young peas, the *ovules*, afterwards to become the seeds, spring from its united inrolled margins. These form a spongy ridge projecting into the cavity of the ovary, which is termed the *placenta*. When the carpels are syncarpous, their union may occur in any

degree, *i.e.* in the ovarian region only, in the base or the whole of the stylar region also, or throughout. Thus the two carpels of Saxifrages are only united by the lower part of their ovaries, which are two-chambered : the St. John's-worts have generally three carpels united into a three-chambered ovary, but with three separate styles : in Violets the three carpels are united throughout, so as to have but one ovary, style, and stigma; but, the margins of the carpellary leaves meeting without being inrolled, there is only one chamber to the ovary, the three placentas being on its side walls (*parietal*), instead of forming a *central* column, as in the St. John's-worts. In some cases the ovules arise from the base of a one-chambered ovary, which may be formed by one or more carpels ; or from a central placenta, which is *free*, *i.e.* has no apparent partitions connecting with the side walls of the ovary ; or even from the general inner surface of the ovary. Thus we have what is termed *parietal placentation* in the Violet, *central placentation* in the St. John's-wort, *basal placentation* in the *Compositæ*, *free central placentation* in Pinks and Primroses, and *superficial placentation* in Poppies and Water-lilies.

The number of carpels in a syncarpous ovary may be determined externally, by lobing, as in the Lily, or by the number of styles, or by the number of chambers seen in a cross-section ; but, besides the partitions or *septa* formed by the inrolled margins of the carpellary leaves, various *false septa* occur, either ingrowths of the midribs of the carpels, as in Flax and Poppies, or longitudinal or transverse ingrowths from the placentas, as in the *Cruciferæ*, in the Milk-vetch (*Astragalus*), etc.

An important character is whether the ovary is *superior*, *i.e.* free from all adhesion to the receptacular tube, as in Lilies, Primroses, Heaths, or Nightshades, for examples ; or *inferior*, *i.e.* enclosed within this tube and thus appearing prominently below the calyx, as in Daffodils, Whortleberries, Gooseberry, and all *Compositæ* and *Umbelliferæ*.

The style may be absent, as in Poppies, when the stigma becomes sessile. Though generally springing from the apex of the ovary, or *terminal*, it may be *lateral*, as in the Strawberry, or may rise from the depressed centre of a ring of carpels, when it is termed *gynobasic*. It is

sometimes single below but divided above, as in most *Compositæ*, in which it bifurcates, and in *Iris* in which it separates into three flattened or *petaloid* portions. In Primroses, Wood-sorrel, Flax, Purple Loosestrife, and some other cases, there is a remarkable variation in the relative lengths of stamens and styles in different individuals of the same species, known as *heterogony*, the pollen from any stamen being found to be *prepotent*, *i.e.* to germinate sooner, upon the stigma of a style of the same length, which will only occur on a different individual. As anther and stigma of parts of equal length will obviously touch the same part of the body of any visiting insect, this is an adaptation to secure cross-pollination.

The stigma may be a line of receptive surface sticky with a sugary secretion, as on the inner surface of the Y-shaped style in *Compositæ*, or it may be nearly spherical, as in the Primrose. In plants pollinated by wind, such as Grasses and Salad-Burnet, it is a feathery plume-like structure.

When the pollen reaches the stigma and begins to *germinate*, or send out its slender pollen-tubes, which are, of course, microscopic, down through the style into the ovary, and so to the ovules, the perianth generally withers, and corolla, stamens, and sometimes sepals, fall off, while the ovary, and the ovules it contains, enlarge. In some Orchids it is not until pollination that the ovules make their first appearance on the placenta.

Ovules

The number of ovules varies from one or two in each chamber of the ovary up to several hundred ; but some of them often fail to develop, so that, though each seed has been an ovule, the number of seeds in a fruit by no means necessarily agrees with the number of ovules there were in the ovary. The ovule is known as a *seed* from the moment when the pollen-tube has entered it so as to fertilise it or "set the seed."

Fruit

The *fruit* is formed of the ovary and any other adherent parts of a flower that persist after this fertilisation. Among existing plants it is only in a comparatively small number, represented here by the Pine, the Juniper, and the Yew, that the ovule is not enclosed in an ovary. These plants, all of which are woody, are known as

Gymnosperms (Greek γυμνὸς, *gumnos*, naked ; σπέρμα, *sperma*, a seed) in contradistinction to all other Flowering Plants, which are *Angiosperms* (Greek ἀγγεῖον, *angeion*, a case or receptacle). Gymnosperms have neither ovary, style, stigma, nor fruit, their pollen-grains falling directly upon, and then in germination penetrating, their naked ovules. These ovules are generally borne on the scales of a *cone*, whence one large group of Gymnosperms are known as *Conifers*. Fruits, like the ovaries from which they mainly originate, may be monocarpellary or polycarpellary, apocarpous or syncarpous, superior or inferior. In the course of ripening they generally enlarge and may either dry up like a withering autumn leaf, or become juicy and soft or succulent. These latter often change colour from green to yellow, red, or less commonly blue or black ; and their juice from being acid may become sweet by the development of sugar. Dry one-seeded fruits, such as those of Grasses, *Compositæ*, and many catkin-bearing trees, do not, as a rule, split open when ripe, being termed *indehiscent*. Dry fruits containing two or more seeds commonly either split into one-seeded portions (*mericarps* or *nutlets*), *i.e.* are *imperfectly dehiscent*, and are known collectively as *schizocarps* (Greek σχίζω, *schizo*, I split ; καρπὸς, *karpos*, fruit), as in *Umbelliferæ*, Mallows, Cranes-bills, Spurges, Mints, etc. ; or are *dehiscent*, splitting so as to disclose their seeds, as in Peas, Violets, Primroses, and Poppies, etc. Succulent fruits do not, as a rule, split open when ripe.

We may describe some twelve types of fruit commonly represented among British plants. Of these three are monocarpellary, the *caryopsis*, or grain, the *pod*, and the *drupe*. The *caryopsis* (Greek κάρυον, *karuon*, a nut ; ὄψις, *opsis*, resemblance) is the dry, indehiscent, superior, one-seeded fruit, or "grain," of Grasses, including our cereals, in which the seed completely fills the fruit. It is often surmounted by the remains of the feathery stigmas by which the wind-borne pollen was received. The *pod*, or *legume*, the characteristic fruit of the Pea and Bean Family (*Leguminosæ*), is dry but completely dehiscent and many-seeded, splitting both between the inrolled margins of the carpellary leaf and down its midrib. The two halves or *valves* often contract violently into a spiral, thus jerking the seeds to a considerable distance. The *drupe*, or stone fruit, characteristic of the Tribe

Pruneæ of the Family *Rosaceæ*, including Plums, Cherries, Almonds, etc., is succulent, indehiscent, and generally one-seeded. It is made up of three layers—the *epicarp* or skin, the *mesocarp* or flesh, and the *endocarp* or stone, the seed being the kernel. Polycarpellary fruits will be either apocarpous or syncarpous. The former are all termed *etærios* (Greek ἑταῖρος, *hetairos*, a companion). The separate carpels (*fruitlets* or *carpids*) of an etærio may be either dry and one-seeded (*achenes*, from the Greek ἀ, *a*, not ; χαίνω, *chaino*, I split), as in the Buttercups, Strawberry, Cinquefoils, and Roses ; or dry and many-seeded, splitting down their inner surfaces (*follicles*), as in the Marsh Marigold and the Columbine ; or succulent, like a miniature drupe (*drupels*), with epicarp, mesocarp, endocarp, and kernel, as in Blackberry and Raspberry. These are called respectively etærio of achenes, etærio of follicles, and etærio of drupels.

Syncarpous dry fruits include the *cypsela*, the *nut*, the *samara*, the *schizocarp*, the *siliqua*, and the *capsule*. The cypsela (Greek κυψέλη, *kupsele*, a chest) is the small, dry, indehiscent, inferior, one-seeded fruit of the *Compositæ*, which is often, but not always, surmounted by a crown of hairs or *pappus*, as in the Dandelion and Thistles. The *nut*, characteristic of many catkin-bearing trees, such as Hazel, Beech, Oak, and Hornbeam, differs mainly in being generally larger and having a thicker often woody exterior. The name *samara* is applied generally to winged fruits, whether indehiscent, with a single wing, as in the Ash, or surrounded by a double wing, as in the Elms and Birches, or partially dehiscent into two or more carpels each with a distinct wing, as in the Maples. These wings serve to catch in the wind sufficiently to carry the fruit and its contained seed away from the shadow of the parent tree. *Schizocarps* include dry fruits splitting into two one-seeded carpels, as in the *Umbelliferæ*, among which the so-called "caraway-seed" is a familiar example of such a carpel ; others splitting into three or more carpels, as in the Spurges, Mallows, and Cranes-bills ; and others again in which two carpels divide into four one-seeded "nutlets," which, therefore, each represent a half-carpel, as in Mints, Borage, Hounds-tongue, etc. The *siliqua* is the flattened, two-chambered, many-seeded, pod-like fruit of the Family *Cruciferæ*, in which the two carpels

burst off as "valves," leaving the seeds attached for a time round the frame-work of a transparent partition. This fruit may be long or short, and this partition may be in the direction of its longer or of its shorter diameter; or in other words, the fruit may be compressed parallel to or at right angles to the partition. *Capsules* are dry, many-seeded fruits which dehisce in various ways and occur in many different Families. In Poppies, Snapdragons, and Toad-flaxes the capsules open by *pores* or little holes near the top. In Primroses and Pinks they split open partially at the top into a circlet of *teeth;* and in both these cases only a few seeds will be shaken out of the fruit at a time. In Pimpernels and in the Henbane the capsules split all round *transversely*, so that a little hemispherical lid falls off; whilst in Violets, Orchids, and the majority of instances they split longitudinally into *valves*.

The chief syncarpous succulent fruits are known as *berries* and *pomes*. The term *berry* is commonly applied alike to superior fruits like those of the Nightshades and to inferior ones, which will be surmounted by the withered calyx, as in the Gooseberry. Berries are soft throughout and many-seeded; whilst the *pome*, characteristic of the Tribe *Pomeæ* of the Family *Rosaceæ*, is an inferior fruit with a core. This core, which may be parchment-like, as in the Apple, or stony, as in Hawthorn, is, in fact, the ovary, most of the surrounding flesh being the adherent receptacular tube which carries the withered calyx to the top. Berries and the smaller pomes, such as those of the Hawthorn or Mountain Ash, are commonly swallowed or eaten piecemeal by fruit-eating birds, which, unlike those which habitually feed upon seeds, have not got muscular gizzards. Thus the seeds of these fruits are neither crushed nor, in many cases, digested by the bird.

Seed

In indehiscent fruits, such as the Hazel-nut or the Almond, the seed has very often a rough brown outer coat or *testa*, whereas in dehiscent fruits, such as the pods of Peas and Beans, the seeds are often conspicuously coloured and highly polished. The testa is generally thick, leathery, impermeable, and bitter, and has often the property of resisting for a considerable time the penetration of water or the action

of the digestive juices of animals. Some seeds of dehiscent fruits are more or less surrounded by a fleshy outgrowth known as an *aril*, which is often brightly coloured, as in the Spindle-tree, and serves as an attraction to birds ; others, such as those of Willows, Poplars, and Willow-herbs, are furnished with tufts of hair, which are known as a *coma*, and aid considerably in the dispersal of the seeds by wind.

Internally, one of the most important differences between seeds is whether they contain a food-store or *albumen* apart from the embryo or young plant, when they are termed *albuminous*, as in Buttercups, Pinks, and most Monocotyledons ; or whether the embryo entirely fills the seed, which is then termed *exalbuminous*, as in Orchids, *Cruciferæ*, *Leguminosæ*, *Compositæ*, etc. The albumen may be starchy or oily, mealy or horny ; and the embryo may occupy various positions with regard to it, being coiled round it in the Pink Family and lying at one side of its base in Grasses.

Division I.

GYMNOSPERMIA

Class I.

CONIFERÆ

I.—THE SCOTS FIR.

Pinus sylvestris Linné.

FLOWERING Plants, which are known technically as *Spermatophyta* or *Phanerogamia*, are divided into two main divisions, the *Gymnospermia* (Greek γυμνὸς, *gumnos*, naked ; σπέρμα, *sperma*, a seed) and the *Angiospermia* (Greek ἀγγεῖον, *angeion*, a box), according to whether their seeds are, or are not, enclosed in a closed receptacle, the *ovary*. Of these, the Gymnosperms are, geologically, the more ancient, but are now by far the smaller group, including four Classes, about 48 genera, and 450 species.

The two Orders of the *Coniferæ* (the only Class represented in Britain), *Araucariaceæ* and *Taxaceæ*, are distinguished, the former by bearing perfect cones, between the scales of which the seeds are concealed, the latter by less-developed or absent carpels, not forming perfect cones, and with more prominent or exposed seeds surrounded by a fleshy cup. The former includes the Kauri, Monkey-puzzles, Pines, Cedars, Larches, Spruces, Firs, Cypresses, and Junipers ; the latter, the Yews and the Maidenhair-tree. Both are, therefore, represented, though only by one or two species, among British plants.

The Araucariaceæ include two Families, the *Abietineæ* and the *Cupressineæ*, of which the former is characterised by bearing its leaves singly and in a spiral on the shoot, and by having the ovules on the scales of the cone so reversed that the micropyle, or opening by which the pollen enters, faces the axis of the cone.

The genus *Pinus* is by far the largest among Gymnosperms, comprising some seventy species, *i.e.* one-fifth of the whole. They are all evergreen trees, abounding in resin and bearing needle-like leaves and woody cones ; and occur, generally "socially," or in "pure" forests, in the North Temperate Zone, or on mountains in the northern part of the Tropics. They produce two kinds of shoots, "long" and "short" ; the long ones bearing only scale-leaves, but increasing indefinitely in length ; whilst the short shoots are of limited growth and bear a sheath of scale-leaves and the needles, of which there are two, three, or five on each shoot, according to the species. The scales of the cones become woody and thickened at their upper extremities into the rhomboidal *apophyses* which form the *tessellæ* or spirally-arranged mosaic-like masses that constitute the exposed surface of the unripe cone ; and, though when ripe they diverge so as to allow the seeds to fall out, they do not fall off separately, like those of Cedars and Silver Firs, but the cone falls whole.

Most Pines inhabit poor, dry, porous soils, into which they send down deep branching tap-roots ; and the needle-leaves show adaptations to a scanty supply of water in their very thick epidermal and hypodermal cells and in the stomata (or transpiration-pores) being few in number and sunk at the bottom of deep pits. It is this *xerophytic* habit that renders our Scots Fir or Northern Pine so much better suited to the poor Bagshot and Lower Greensand wastes of Surrey and Bedfordshire than are our broad-leaved trees.

Since *Pinus sylvestris* forms a vast belt of forest land from Kamtschatka across Siberia and Northern Russia into Prussia, Sweden, and Norway, and is shown by its occurrence beneath the peat-bogs and in the submerged forests to have been formerly also indigenous in Denmark, England, and Ireland, it has been suggested that it may be known as the Northern Pine rather than bear a name taken from the one part of the British Isles where it now grows truly wild in a very restricted area. The name "Fir," moreover, might well be restricted to another group, the Silver Firs, so as to make the popular names Pine, Spruce, and Fir correspond to the three distinct genera—*Pinus*, *Picea*, and *Abies*. Whilst in the Scottish Highlands this species does not grow at altitudes of over 2,200 feet above sea-level ; at its southern limit, in the mountains of Southern Europe, such as Etna, it reaches 7,000 feet, and in the Caucasus 8,000 feet, though only in a stunted form.

At first conical in general outline, with its slender branches rising slightly from the main stem, the Scots Fir in Britain reaches full maturity in from seventy to a hundred years, and is generally felled at a less age ; but it is stated to grow much more slowly in Norway, where it has attained an age of four centuries. Accustomed as we are to the shorter much-branched stems of most of our deciduous broad-leaved trees, this tree has become the very type of lofty uprightness. Its straight stem, seldom exceeding twelve feet in girth, reaches fifty to a hundred feet in height, while its branches are comparatively insignificant. When old, the tree assumes a spreading, flat-topped, Cedar-like outline, and its boughs are often twisted into gnarled forms. One of its great beauties is the rough reddish or copper-tinted bark, made up of flaky scales above, but thicker, darker, and deeply ridged towards the base of the stem.

The needles in this species are in pairs on the short shoots, not more than two or three inches long, pointed, grooved along their upper surface, curved, and often twisted, finely toothed throughout their length, and coated with wax, which contributes to the remarkable dark indigo tint that lends to the tree its air of gloom. This is more especially true of the flat upper surface of the needle, its rounded under surface being a dark green. The needles remain on the tree for from two to five years, and the short shoots are shed whole, each with the two needles it bears.

The flowers open in May or June, both male, or pollen-bearing flowers, and female, or seed-bearing ones, being borne on the same tree. The male flowers are egg-shaped, yellow cones of scale-like stamens, a number of flowers, each about a quarter of an inch long, being clustered together. As the anthers split they discharge clouds of sulphur-yellow pollen. The female cones are purplish, egg-shaped, and at first erect ; but after fertilisation, which process takes more than a year to complete, they hang downwards on short stalks. By August they become greyish-brown ; but they never acquire the high polish characteristic of some other species of Pine.

II.—THE COMMON JUNIPER.

Juniperus communis Linné.

THE Family *Cupressineæ* are distinguished from the *Abietineæ*, of which *Pinus* is an example, by having their leaves and the scales of their cones arranged in whorls, instead of being borne singly in spirals, and by having their ovules erect, instead of inverted. Many of them, including some species of *Juniperus*, have minute green scale-like leaves closely pressed to the stem, so that this type of leaf is termed *cupressoid*; but that is not the case with the Common Juniper.

In the number of its species the genus *Juniperus*, the only genus in a Tribe known as *Juniperinæ*, is second only, among the Coniferæ of the Northern Hemisphere, to *Pinus*, comprising as it does some thirty different kinds. Though some of these are merely shrubs, others reach the dimensions of good-sized trees. The fragrant reddish wood of *Juniperus virginiana* L. and *J. bermudiana* L. is that employed, under the name of "cedar," for making lead-pencils.

The needle-shaped leaves of Junipers are sometimes in opposite pairs, but more commonly in whorls of three, so that the three leaves in each whorl diverge at an angle of 120°. These whorls "decussate," *i.e.* the leaves in any one whorl stand over the spaces between the leaves of the next whorl below. There are thus six vertical rows of leaves along the stem. A yet more distinctive character of the genus *Juniperus* is the fleshy, roundish, berry-like cone, in which the seeds are so embedded that it is somewhat difficult to recognise that the plant is a gymnosperm.

The Common Juniper (*Juniperus communis* L.) may reach twenty or even thirty feet in height; but is more commonly a small shrub from three to seven feet high, and in alpine and Arctic situations becomes a prostrate undershrub. It is of slow, or very slow, growth, and the main stem is generally overtopped by its branches at an early stage. It is only in the taller tree forms that the stem reaches a foot in diameter; but in much smaller specimens the stringy reddish-brown bark may be seen coming away in long strips from the deeply furrowed surface. The branches commonly take an erect, ascending or "fastigiate" direction; and as they spring near the base of the stem the whole plant assumes the habit of a Cypress or of a Lombardy Poplar; but on windy hill-sides it is often blown over or made to spread out more horizontally than vertically and thus assumes a great variety of forms.

The internodes of the shoots are triangular, the leaves being borne on the angles; and the leaves are straight, rigid, awl-shaped, with a long, stiff, sharp point, and from half an inch to an inch in length. The leaf-margins are slightly thickened or inrolled, thus making the upper surface of the leaf concave and this hollow is lined with white wax, so that the leaves appear green below and glaucous above. In the dwarf alpine and Arctic form the needles are shorter, blunter, curved, and pressed against the stem. Though the flower-buds form in autumn, the flowers do not open till April or May, and, except in rare cases, the male and female blossoms are on distinct plants.

The male flowers are little yellow oblong cones, each consisting of several whorls of stamens, three in each whorl, as in the foliage-leaves. So too the little bud-like female flowers consist of two or three whorls of three scales, the lower ones membranous, while the three uppermost become fleshy and are carried up over the young seeds after fertilisation by a cup-shaped ring growing from below. Between these three carpellary scales are the three ovules, which project until the pollen-grains have found their way—carried by wind from a male bush—into their micropyles, after which they become embedded.

The berry-like structure thus formed, showing the tips of its carpels as projecting points a little removed from its summit, remains green and dry during its first year ; but by the autumn of the second year has become soft and juicy, from a fourth to a third of an inch in diameter, and of a blue-black colour, with a grey waxy bloom. As the juice contains sugar it is fermentable.

The enclosed seeds become hard and bony externally but also develop several large resin-glands in their testas, so that the "rob" or extract from the ripe fruits and their contained seeds is sweet, resinous, and strongly flavoured. Physiologically, all this is an adaptation of the seeds for dispersal by the agency of birds ; whilst the dry winged seeds of Pines are mainly disseminated by wind. While the inconspicuous green fruit is dry and unattractive, by the time it has become conspicuously coloured and juicy the seeds are protected by the hardening of the testa, so that when the fruit is eaten by birds the seeds are not injured in passing through the birds' bodies.

The two cotyledons of the embryo are not divided as are those of the Pines.

The fine and close-grained and very durable wood of the Juniper is sometimes used on the Continent for whip-handles, vine-stakes, and turnery ; and, as it is pleasantly fragrant when burnt, it is also employed for fumigation. In the early part of the seventeenth century it was the custom for tobacconists to keep a fire of juniper wood alight at which their patrons might light their pipes. The best-known use of the Common Juniper is, however, the employment of its berries as the flavouring of gin, for which purpose they are imported from Germany and Holland.

In Germany it is commonly seen of a considerable height on open sandy heaths, as it is also at Burnham Beeches on gravel overlying chalk ; but with us it is more familiar on the sunny slopes of the chalk downs. It will, however, flourish on non-calcareous soils, in wet moorland, and under the shade of other trees. Its geographical range is from Northern Africa and the Himalaya to Northern Siberia, Lapland, Iceland, and North America.

When cultivated at high altitudes it assumes the distinctive characters of the dwarf form (*J. nana* Willdenow), while this latter when grown in the plains of Central Europe becomes to all intents and purposes the common form, so that they cannot be considered as separate species.

Several species are in cultivation and are propagated either by seed, by cuttings, by layering, or by grafting on the Common Juniper.

III.—THE COMMON YEW.

Taxus baccata Linné.

FEW trees have such interesting associations with social and religious history, folk-lore, and poetry as the Yew, whilst botanically it also occupies a very isolated position. The majority of the types included in the Order *Taxaceæ* belong to the Southern Hemisphere. Though we need not follow Sir Joseph Hooker in considering all Yews, including the Californian and Japanese forms, as merely varieties of our well-known species, they undoubtedly constitute a group as structurally compact as it is geographically widespread.

Luxuriating in warm calcareous or sandy soils, but by no means exacting in its requirements in this respect, the Yew is a deep-rooted tree. In the Himalaya it even grows to 100 feet in height ; but with us it rarely reaches half that height and is sometimes a mere bush.

Although it has been estimated that the increase of the diameter of the stem may not exceed a line a year throughout its life, this may, considering the great girth of some trees, represent a very fair total cubic amount of wood ; and undoubtedly exaggerated estimates of the age of large Yew-trees have been arrived at by ignoring a striking characteristic in their mode of growth. The Yew possesses exceptional powers of developing new shoots from dormant and secondary buds ; and it is to this capacity that it owes its employment in clipped hedges and in the once favourite "topiarian" gardening. A large and ancient Yew, for instance, in the churchyard at Harlington, Middlesex, which in the eighteenth century was fantastically clipped into spires and balls, has at present every appearance of an untouched tree. At a comparatively early age some of the branches may grow erect so as to give the tree several leaders ; and later on many shoots rise erect around the base of the stem and become eventually enclosed in a common bark, thus giving rise to a fluted stem of deceptively great dimensions, which, if cut through, would exhibit many distinct centres of growth.

The rosy-tinted bark which comes away in thin papery flakes is characteristic of a growth which is certainly slow ; as is also the fact that the dark-green leathery foliage remains on the tree for from four to eight years ; and, as a result of this slow growth, no European conifer is as tolerant of shade as is the Yew. On the other hand, so deep is the shade which it itself casts that there is less vegetation beneath it than beneath any other species.

The leaves are borne singly and in a spiral round the shoots ; they have very short stalks, are from a third of an inch to an inch and a half long, with parallel sides, a pointed apex, a polished upper surface and a paler green lower one. Though in seedlings and erect shoots the leaves continue to radiate in all directions, on the lateral branches, by a slight twisting of their stalks, they are all reduced to two rows lying in one plane like the barbs of a feather.

The Yew is in general diœcious, the flowers of both kinds being formed in autumn on minute scale-bearing twigs, but maturing between February and April. The male flower is yellow, globular, about a quarter of an inch in diameter, and borne below the leaves of a spray. It consists of from six to fifteen spirally-arranged peltate stamens, each of which bears from five to nine pollen-sacs on its under surface. In dry weather these burst open and discharge clouds of fine dry dust-like pollen. The female flower consists of a single naked ovule. This is at first green and terminates a lateral outgrowth from the little scale-bearing twig just mentioned. Below it are three pairs of green scales, which, however, in no way adhere to the erect ovule. The ovule has but one integument, but before pollination a drop of viscid liquid exudes from the micropyle, as is also the case in the Juniper. This serves to capture the wind-borne pollen-grain, and by drying up draws the grain down into the micropyle. After fertilisation the green seed becomes surrounded by the well-known pretty pink cup-shaped aril, which is mucilaginous and is perhaps protected from damp by a slight waxy bloom that covers it. This aril serves, like the fleshy berry of the Juniper, to attract birds, and by their means the seeds are so dispersed that we may often see a Yew-tree waving from a church tower or from the face of a precipitous crag. The pink aril is harmless, but the green parts of the plant contain a poisonous alkaloid, known as *taxin*, which may, perhaps, be largely formed in the leaves when branches have been clipped. While many animals browse on the shoots with impunity, cattle are often killed when they eat the clippings, as they will with avidity.

The wood of the Yew is remarkable among conifers for containing no resin. It is a reddish-brown, resembling mahogany, heavy, very hard, close-grained, tough, susceptible of a high polish, insect-proof, and more durable than any other European wood, especially in contact with the soil, so that, according to an old saying, "a post of yew will outlast a post of iron." It was used for early Greek statues of the gods, and is still sometimes employed for furniture, as is the allied species in Japan. Its most remarkable character, however, is its flexibility and elasticity ; and it has been suggested that this property may be connected with its internal structure, for it is entirely made up of elongated cells with spiral thickenings to their walls. This elasticity led to its early use for making bows, to which purpose the Japanese species was also applied by the aboriginal Ainu, and to this it may owe its Latin name *Taxus*, if this can be connected with the Greek *τόξον*, *toxon*. It was to bows of Yew that we mainly owed the victories of Crécy and Poitiers ; but, though home-grown wood was used, it only fetched one-third the price of that brought by Venetian traders from Italy, Turkey, and Spain. Though bows are now largely made of Lancewood and Hickory, Yew is still employed.

The slow growth and apparent immortality of this evergreen tree seems the root-idea in all those vernacular names in which it is inextricably confused with the Ivy, such as the Old English *ew* or *iw*, the Welsh *yw*, and the French *if*.

IV.—ANALYTICAL DRAWINGS OF CONIFERS.

RECENT discoveries among fossil plants have done much to bridge over the gap separating Flowering from Flowerless Plants. A group of plants has been found having fern-like fronds associated with stems with a structure resembling those of Gymnosperms and with fully-formed seeds. Of the existing Classes of Gymnosperms, these plants are nearest to the *Cycadeæ;* but it is not at all certain that we are now justified in classing *Cycadeæ*, *Coniferæ*, and *Gretaceæ* in the one Division *Gymnospermia*, if by so doing we mean to suggest that they have had one common ancestry. They may have originated independently from different branches of the great alliance or Sub-kingdom of *Pteridophyta* or fern-like plants. As the Cycads appear to be descended from fern-like plants, so the *Coniferæ* are, perhaps, more closely related to the *Lycopodinæ* or Club-mosses.

While all existing Gymnosperms are trees, or at least woody, it has been suggested that the ancestral forms of these groups and of the fruit-bearing Division of Flowering Plants or *Angiospermia* may probably have been smaller herbaceous forms.

There seems to be clear evidence that most of the main divisions of the Gymnosperms go back to a remote geological past ; and, whatever may have been their order of origin, they may still be tentatively united by the character of the seed, which is not enclosed in an ovary, becomes partly filled with a nutrient tissue or *archisperm* resembling the *prothallus* in the *megaspore* of *Selaginella*, before fertilisation, and is pollinated directly, without the intervention of a stigma.

Some hesitation has also been felt as to whether we can even assign a common origin to all those trees which we term *Coniferæ*, the Maidenhair-tree, *Ginkgo biloba* Linné, of China and Japan, presenting many very isolated characters, coupled apparently with a great geological antiquity. Even the two Natural Orders, *Araucariaceæ* and *Taxaceæ*—into which all the Class *Coniferæ* is now divided, and both of which have British representatives—are very widely separated ; and the very ancient divergence of their various subdivisions is illustrated by the fact that no species and very few genera of *Coniferæ* are common to both the Northern and the Southern Hemisphere. Of the thirty-seven genera, in fact, fourteen are northern, twelve are southern, and nine are confined to the Chino-Japanese area.

Coniferæ agree in being woody plants, usually with one main stem of preponderating development and slight branches apparently whorled. The wood is added to *exogenously* by annual rings. Their leaves are usually either flat scales closely adpressed to the stem or are narrow, needle-shaped, or linear. Most of them are evergreen and have the thick cuticle and sunken stomata of xerophytes. They are all wind-pollinated, producing enormous quantities of light pollen, but no nectar, whilst a drop of viscid liquid appearing in the micropyle of the ovule receives the pollen-grain and draws it down to the *nucellus* or body of the ovule. Pollen and

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ovules are in all cases borne in distinct flowers ; but these may be on the same tree (*monœcious*), as in *Pinus*, or *diœcious*, as in the Yew.

In the Order *Araucariaceæ*, to which both the Scots Fir and the Juniper belong, the seeds are borne on fully-developed cones.

The Scots Fir represents the Family *Abietineæ*, which is characterised by spirally-arranged leaves and inverted ovules. It has its needle-leaves in pairs on short shoots, or shoots of limited growth, wrapped round at their bases by scale-leaves ; while the long shoots bear scale-leaves only. Each apparent whorl of branches on the main stem marks a year's growth. The flowers, both male and female, are cone-shaped and are, in fact, specially modified short shoots. The male or staminate flowers are grouped together in a spike, as represented in the first figure in the first row on our Plate. Fig. 2 is a single male flower made up of a number of stamens, each bearing two pollen-sacs on its under surface. Each pollen-grain has two bladder-like floats. The female cone (Figs. 4, 5, 6) is made up of numerous small outer or "carpellary" scales, each with a larger "ovuliferous" scale above it ; and it is the woodily-enlarged rhomboid apices of these latter that form the "tessellæ" of the surface of an unripe cone (Fig. 5). The seventh figure in the first row shows one young ovuliferous scale, with its two ovules, as seen from below and from above. The cones take two or three years before the seeds are ripe. The eighth figure is the inner or upper surface of a scale bearing its two seeds ; the ninth, a seed, natural size ; and the tenth, the same enlarged. In this species each seed is furnished with a wing-like process, which aids in its dispersal by wind. The scales of the cone spread apart in the first June to admit the pollen, close up again, to diverge once more when the seeds are ripe. The eleventh figure shows a seed in section, exhibiting the deeply-divided cotyledons of its embryo.

In the Juniper, representing the Family *Cupressineæ*, the leaves are in whorls of three. The first figure in the second row is a staminate branch and the second a single stamen. The third figure shows the young female cone of three scales ; the fifth figure representing one opened so as to show the ovules which alternate with the scales ; the fourth being a ripe "berry" ; and the sixth, a cross section showing the three seeds.

The first figure in the third row is a staminate branch of the Yew ; the second, a single staminate flower, a cluster of peltate stamens ; while the other figures exhibit the gradual development of the solitary ovules which, after pollination, become surrounded by the pink, juicy, cup-shaped "aril," which serves to attract birds.

Division II.

ANGIOSPERMIA

Class I.

MONOCOTYLEDONES

V.—THE BULRUSH.

Typha latifolia Linné.

SOME of the groups in which plants are classified are apparently linked by intermediate forms, or do not recommend themselves equally to all students of plant-anatomy. Among living plants, however, the enclosure of the ovule in an ovary and the reception of the pollen-grains on a special viscid surface or stigma seem to mark out a great natural Division, the *Angiosperms*, separating them from the group of *Gymnosperms*, some types of which we have just described. Among the Angiosperms two natural Classes are so clearly defined by characters drawn from every part of the plant that the distinction between Monocotyledons and Dicotyledons was long ago recognised by John Ray and other early botanists. Though there are exceptional cases, it will be sufficient here to say that in Monocotyledons the primary or tap-root is not as a rule developed, its place being taken by a bunch of unbranched fibrous rootlets ; that if the stem is perennial it will develop scattered "woody bundles" in its interior but not annual rings of wood ; and that, as it does not increase in diameter by means of a *cambium*, or layer of growing tissue, below the bark, there is no readily removable bark ; that the leaves are usually simple, exstipulate, entire, and parallel-veined, and very often highly polished and glossy ; that the parts of the flowers are very often in whorls of three ; and that, as the name indicates, there is only one fully-formed cotyledon or seed-leaf in the embryo plant within the seed.

The Class includes, in addition to the groups here represented, the Grasses and Sedges, and such exotic Families as the Palms, Screw-pines, Bananas, Gingers, and Arrow-roots.

The Order *Pandanales*, named from *Pandanus*, the Screw-pines, includes two British Families, the *Typhaceæ* and the *Sparganiaceæ*, its chief general characters being that the flowers have either no perianth or one reduced to uniform hairs or bracts, and are collected into closely crowded spherical or cylindrical inflorescences, with stamens and carpels in separate flowers, and that the embryo is surrounded in the seed by the food-store known as *albumen*.

The Family *Typhaceæ* is but a small one, containing only the one genus *Typha*, of which there are about a dozen species, widely distributed over the Tropical and Temperate regions of the globe, especially in the Northern Hemisphere. Growing as they do in marshes or by the side of stagnant or running waters, they derive their generic name *Typha* from the Greek τῦφος, *tuphos*, a marsh.

Buried in the mud are the thick creeping stems or rhizomes which are filled with a store of starch with, however, an astringent taste that has led to their use in Eastern Asia for medicinal purposes. From them are given off many thick roots, and the erect, wand-like, cylindrical, aerial stem, from the lower part of which alone are leaves given off. The leaves are sword-shaped, rising erect in two vertical rows, narrow in proportion to their length and sheathing at the base ; and, as is the rule

among Monocotyledons, both stem and leaves are free from hairs. The most distinctive feature of the Family is, however, the long, dense, cylindrical spikes of the flowers. Thus in his "Names of Herbes" (1548) William Turner writes :—

"Typha groweth in fennes & water sydes among the reedes, it hath a blacke thinge Almost at the head of the stalke lyke blacke veluet. It is called in englishe cattes tayle, or a Reedmace, in Duche Narren Kolb, or Mosz Kolb."

The lower cylindrical portion of the spike, which is rather of a rich dark brown than black, at least when young, consists of the carpellate flowers, while the tapering yellowish upper portion is made up of the staminate ones, and withers and disappears after the discharge of the pollen. Below the staminate flowers are a few scattered deciduous scale-like bracts, and each flower is surrounded by numerous slender bristle-like hairs, which may be termed a perianth. There are generally three long straight yellow anthers with very short filaments and slightly projecting points or *connectives;* but they are united below on a short stalk, and there has been some controversy as to their developmental history or *morphology*.

The carpellate flowers are borne on short stalks which spread horizontally from the main axis and are surrounded by the numerous hairs which produce the velvety appearance of the spike. The one seed in each ovary is said to be the apex of the flower-stalk, the ovary growing up round it as a single tubular carpel. The ovaries that bear seed are tapering at both ends and are surmounted by a slender style and a lanceolate stigma ; but there are also a number of shorter and broader ovaries with hardly any style, which come to nothing. They have been called "rudimentary"; but "vestigial" would probably be a more accurate term.

Typha latifolia is our largest herbaceous aquatic plant, often growing from six to eight feet in height. Its nearly flat leaves are about an inch across and nearly as long as the stem, and are covered with a slight glaucous waxy bloom. The brown velvety spikes are nearly a foot in length ; in their early stage there is no gap between the "fertile" or carpellate and the "barren" or staminate portions, but, when the wind has carried the pollen to the stigmas of some other individual and the stamens have withered, the velvety spike of fertile flowers increases to an inch or more in diameter ; and ultimately as the ripe fruits split open it breaks up into a mass of loose down and dry capsules.

As the decision as to the use of a popular name at any period must rest with the users, we have ventured to call this plant the Bulrush, rather than Cat's-tail or Reed-mace, since undoubtedly it is most commonly called by the first name, though that formerly belonged to a very different plant, *Scirpus lacustris* L. Parkinson proposed to call it "Torch-reed," and mentions the use of its leaves to make mats and children's chairs, from which it got the name of "Mat-reed." "Livers" or "Levers," possibly the first half of the name of Liverpool, it shares with other sword-leaved plants; but the prettiest of its many appellations is Gerard's "Lance for a lad."

VI.—THE BRANCHED BUR-REED.

Sparganium erectum Linné.

THERE are many charms alike of structure and of association that belong to our water-side flora. The neighbouring water forms a cool and refreshing background for the observer, whilst the constantly renewed and thus well aerated supply at the roots secures a healthy and vigorous growth of the plants themselves. Among them there are also many forms of exceptional beauty both of form and colour. The floating blossoms of Water-lilies or the graceful foliage of the Arrow-head may be succeeded towards the bank by a tangle in which Tufted Vetch may straggle over the slender branches of the Water-plantain, the sky-blue of the Forget-me-not peep out between the golden stars of the Flea-bane, or the blushing umbels of the Flowering Rush stand over the large purple blossoms of the Meadow Cranes-bill.

Less striking in colouring but no less beautiful in form, the Branched Bur-reed is a frequent member of such associations of plants, whose attractions have, we think, been too often overlooked.

Like its near ally the Bulrush, it belongs to a Family consisting of a single genus. The *Sparganiaceæ*, like the *Typhaceæ*, are perennial herbaceous plants with their horizontal rhizomes buried in the mud, while the leaf-bearing aerial stem rises above the water. As in the *Typhaceæ*, too, these stems are round, with cylindrical internodes becoming somewhat smaller upwards, smooth and solid, and the leaves are all cauline, springing, that is, from the aerial stem and not from the rhizome. The leaves are also distichous, simple, linear, and entire. It should, perhaps, be noted, however, that when these plants are young there is but little sign of the horizontally creeping rhizome, the tufted roots springing practically from the base of the aerial stem. The leaves in some species are triangular in section at the base, with three concave surfaces, but become flatter towards their apex. Their long parallel-sided apical portions give the genus *Sparganium* its name, which is derived from the Greek σπάργανον, *sparganon*, a swaddling band; and, though generally ascending, they are not so strikingly erect as those of *Typha*. Softer and more pliable than those of their neighbours the Sedges, they are often used for packing, and their edges do not cut the hands of the gatherer as do those of the last-named group.

The distinctive feature of the group, however, is the spherical inflorescence, just as the cylindrical arrangement is characteristic of the *Typhaceæ*. Like their allies, they are monœcious, and the clusters of staminate flowers are higher up the stem than those of carpellate ones. This practically implies that the carpellate flowers are formed earlier, and thus explains why, in this group, they mature sooner than the stamens, the stigmas being in a sticky receptive condition before the stamens are ready to discharge their pollen. The wind has thus to carry the pollen to the stigma of some other individual which is in a somewhat more backward condition. Such "protogyny" is, however, a general rule among wind-pollinated, or *anemophilous*,

plants, and in many cases there is not so simple an explanation of its occurrence as there is here. As for the later development of staminate flowers, it is a common phenomenon, as in the clusters of the Horse-chestnut, and is generally explained as due to the lessening vigour of the flowering shoot after the physiologically exhaustive process of forming the lower, perfect, or in this case carpellate, flowers.

Each flower in either type of cluster has from two to six small, oblong, obtuse, membranous bract-scales below it. The stamens are from two to eight in a flower, and differ from those of *Typha* in not being united below and in not having a projecting connective above. The pale anthers become yellow as they mature, so that the smaller balls of flowers formed by them contrast beautifully with the large glossy green carpellate structures and their translucent colourless styles.

Parkinson in 1640 described the carpellate inflorescences as

"small greene burres, which are not rough at the first, but growing ripe are hard and prickly, somewhat resembling the rough burres of *Platanus*, the Plane-tree."

The ovaries differ somewhat in size and shape in the various species—about ten in all—and in the length of the styles and forms of the stigma. There are sometimes two united carpels forming a two-chambered ovary and a bifurcating style ; but in all cases the fruit becomes dry and membranous externally, surmounted by the persistent style, and with an almost woody endocarp or stone, and does not split. The ovule is suspended from the side of the upper end of the ovarian cavity and inverted, so that it has a slender suspending thread or *raphe* down one side, as has the kernel of the Hazel-nut, and its micropyle is brought round close to the point of attachment. The ripe seed is ovate and contains a straight embryo in the centre of mealy albumen.

The geographical distribution of the genus is much the same as that of *Typha*, occurring, that is, in both Tropical and Temperate latitudes, chiefly in the Northern Hemisphere, but represented also in Australia and New Zealand.

The Branched Bur-reed (*Sparganium erectum* L.) grows to a height of three or even four feet, branching chiefly in the upper, flowering region. Here it bears sheathing linear leafy bracts becoming successively shorter, in the axils of which are the branches bearing from one to three carpellate flower-heads, succeeded at a little distance by a larger number of staminate clusters, which are about half the size of the carpellate ones and are of an olive-brown tint when in bud. When they have discharged their pollen these wither and disappear. The ripe fruit is obpyramidal, surmounted by the short, stiff, persistent style, and its seed has a few slight ribs on its surface.

As this plant stands by the river's brim with its golden tufts of ripe stamens above and its silver-tipped burs beneath, the whole supported on a glossy polished stem and backed by luxuriant leafage, it suggests some sparkling masterpiece of the jeweller's craft.

VII.—THE MARSH ARROW-GRASS.

Triglochin palustre Linné.

IT is not without significance that the first seven of our selected types of Monocotyledons are aquatic or semi-aquatic plants. There is much evidence in the structure of the Class that it may be of aquatic, or semi-aquatic, origin. The slight tendency to the formation of wood and frequently soft texture, the scanty rooting system adapted rather to mud than to a windy situation, the glabrous and polished surface, and the entire leaf-margins all point in this direction ; and some anatomical evidence has been adduced in support of the suggestion that the whole Class may have originated from or near such a semi-aquatic group of Dicotyledonous plants as the *Ranunculaceæ*, the Buttercup Family.

Though most of the groups included in the Order *Helobieæ*, which nearly corresponds to Bentham and Hooker's Cohort *Potamales*, are aquatic, it must be admitted that in structural and physiological characters they seem a somewhat heterogeneous assemblage. Among them are the most completely aquatic of flowering plants, such as the fresh-water *Naias* and the Grass-wrack (*Zostera*), so familiar on most sea-coasts, both of which are adapted for pollination under water ; the large genus *Potamogeton*, the Pond-weeds, floating or submerged plants flowering above water ; the beautiful and fragrant Cape Pond-weed or Winter Hawthorn (*Aponogeton distachyum* Thunb.), the curious Lattice-leaf of Madagascar (*A. fenestrale* Hook. fil.) ; besides our British Arrow-grasses, Water-plantains, Arrow-head, Flowering Rush, and Frog-bit. These British representatives of the Order either float on the surface of fresh water, or rise above it, or grow in wet ground by the water's side ; but the *Triuridaceæ*, a small group of Tropical plants included in this Order, are saprophytes with little or no chlorophyll or green colouring-matter in their leaves, growing on dead leaves in the forest.

The flowers of the *Helobieæ* exhibit primitive and variable structural characters which suggest that some at least of the Order may be survivals of early undifferentiated types ; but it must always be remembered that a certain freedom from competition, the equable temperature of the water, and great facilities for dispersal of rooting fragments or of seeds have led to a structural degeneration in many aquatic plants. In other words, in interpreting the structures of such plants it is always important to be on one's guard against considering vestigial structures as truly rudimentary, mistaking degraded higher types for really primitive ones. The perianth in this Order may be absent or may be represented by one or by two whorls of leaves and, in the last case, the two whorls may be similar (*homochlamydeous*) or dissimilar (*heterochlamydeous*) : the parts of the flower may be partly arranged in spirals (*hemicyclic*) or may be entirely in whorls (*cyclic*) ; but in all cases they are polysymmetric. By including the Frog-bit Family (*Hydrocharitaceæ*), we are also obliged to add that the flowers may be epigynous, although

in the great majority of cases they are hypogynous. Both stamens and carpels vary in number within the widest limits, and the latter may be free (*apocarpous*) or united. It is, perhaps, one sign of the degeneration of the structure of the seed, in a group most members of which have great facilities for other methods of multiplication, that, contrary to the general rule among Monocotyledons, there is little or no albumen in the seeds of the Helobieæ.

Of the eight Families comprised in this Order, the Arrow-grasses belong to the *Juncaginaceæ*, a small group of four genera, including in all only about fifteen species. All of them are perennial marsh-plants of grass-like habit, with semi-cylindric or linear leaves, sheathing at the base and having the little axillary or intrapetiolar scales, resembling the "ligules" of grasses, which occur also in the Pond-weeds (*Potamogeton*). Some authorities consider these to be stipules, whilst others employ the ponderous non-committal term "squamulæ intravaginales." Their flowers are generally perfect, with a six-leaved perianth of calyx-like character in two whorls, six stamens, and three or six carpels, which may be distinct or united and are each either one- or two-seeded.

The Arrow-grasses, the name of which genus is merely a translation of the scientific name *Triglochin* (from τρεῖς, *treis*, three; γλωχὶν, *glochin*, an arrow-head), derive their name from the appearance of the fruit of this species, *T. palustre* L., as it splits when ripe. It was known to the early botanists as *Gramen Triglochin*, and in his "Theatrum Botanicum" (1640) Parkinson writes of it :—

"It hath sundry narrow slender leaves foure inches long, among which the stalke that hath no joynt or leafe thereon groweth a foot high, bearing many small three square heads in a long spike one above another, each on a severall short foot-stalke, fashioned somewhat like to a broad Arrow head, or the leafe of *Sagittaria*, but that they are small and rounder, biforked below and sharpe pointed above, the root is a small bush of many small white fibres."

The fruit is, in fact, a schizocarp, not unlike that of *Geranium*, the dry valves of the three carpels separating at their bases and remaining attached to a central angular axis. Before bursting, the capsule is linear, whereas that of the allied species *T. maritimum* Linné is ovate; and the latter has six fully developed carpels, whilst in *T. palustre* there are only the rudiments of three chambers between the three that are fully formed. It is believed that the seeds are dispersed by animals, the sharp barbs of the fruit getting into the fur, or even piercing the skin. Sheep and cows are said to be fond of the salt flavour of the fleshy leaves.

The flowers are wind-pollinated and protogynous, the stigmas reaching maturity two or three days before the anthers are ready to burst. As is usually the case with anemophilous flowers, the stigmas are brushes of rather long hairs. When the pollen is discharged it accumulates in the deeply hollowed perianth-leaves, one of which underlies each stamen, and is thus carried away in a considerable quantity by each gust of wind. The Marsh Arrow-grass flowers from June to August.

The species has a wide latitudinal range in the Northern Hemisphere from Arctic regions to Northern Africa and North-western India.

VIII.—THE GREAT WATER-PLANTAIN.

Alisma Plantago-aquatica Linné.

LINNÉ seems sometimes to have broken his own rule that the names of species should consist of two words only; but by our existing rules such specific names must be written with a hyphen. The result is cumbrous, though far less so than was the pre-Linnæan nomenclature.

The Family *Alismaceæ*—one of the subdivisions of the Order *Helobieæ*—as we limit it, comprises some ten genera and fifty species, widely distributed in all climates and in both the Northern and the Southern Hemisphere. It includes some floating or largely submerged plants; but the majority of them are, perhaps, like the Great Water-plantain, water-side or marsh species. They have generally perennial rhizomes, though, as we pointed out when speaking of the Bur-reed, when the plants are young the fibrous roots spring apparently direct from the base of the upright aerial stem.

The leaves are generally "radical" in origin; but they vary very much in direction of growth and in form, even on the same plant, according to the surrounding conditions, whether, that is, they are only liable to be occasionally submerged by flood waters, or are constantly floating on the surface, or are permanently submerged beneath stagnant or running water. In most cases, however, they have long sheathing petioles; and the little axillary stipular scales or "squamulæ intravaginales," referred to under the last species, are also present.

The inflorescence is usually much branched and the order of development of its successive branchings is somewhat complex, being what is technically termed *mixed*. In this Family the primary branching is racemose and the secondary generally cymose, a clear example of which is seen in the Great Water-plantain itself. The flowers are mostly conspicuous and polysymmetric, though they may, or may not, be perfect. The perianth shows clearly the three-fold symmetry characteristic of Monocotyledons, since it is made up of two differing whorls of three leaves each, the outer whorl being sepaloid and relatively inconspicuous, while the corolla or inner whorl consists of three good-sized petals. The stamens and carpels both vary in number from six upwards. The latter are generally superior, apocarpous, and one-, or rarely two-, seeded, becoming dry in the fruit stage. The ovule is bent on itself like a horseshoe (*campylotropous*), so as to bring its micropyle near to its point of attachment and facilitate the entrance of the pollen-tube as it grows down from the lower end of the short stylar canal. In those cases in which there is only one ovule in each carpel, it rises erect from the base of the ovary, and the carpel, when ripe, is indehiscent; but when there are two or three ovules in each carpel, one occupies this position and the others are horizontal, whilst the ripe carpel is a follicle dehiscing down its inner side. The seeds are exalbuminous and the embryo is curved like the ovule.

The etymology of the name *Alisma*, which seems to have been applied to the Water-plantain by Dioscorides and Pliny, is uncertain, the Celtic *alis*, meaning "water," being the most plausible suggestion. The name *Plantago-aquatica* is also ancient, and is obviously suggested by the prominence of the longitudinal veins in the leaves, which resemble those of the true Plantains of the Dicotyledonous genus *Plantago*, so often too familiar to us on our lawns. It is probably too these strong veins or bundles of vascular tissue, the tissue by which the sap is conducted into and from the leaves, that suggest the book-name Thrumwort, though it is not as easy to draw the veins out of the leaf as threads or thrums in these plants as it is in the case of the true Plantains.

The Great Water-plantain, as a sign of swampy ground not easily eradicated save by proper drainage, may well have been somewhat unpopular with the primitive agriculturist, who was apt to attribute things that he did not like to the father of evil, so that the shape of its leaves naturally originated the Scottish name for the plant of Deil's spoons.

The genus *Alisma* is characterised by its erect leaves, by the grouping of its flowers in cymose umbels of a few blossoms each, by having six stamens formed by the bifurcation of three and united below into a honey-secreting ring, and by its numerous free carpels, which are one-seeded and indehiscent. The flowers are scentless ; but are not of the opaque white that attracts the moths of the dusk, and quite sufficiently conspicuous for the diurnal marsh-flies that constitute the chief agents for their cross-pollination. The nectar is actually secreted by several small rounded glands between the staminal ring and the carpels, so that it is partially concealed, an arrangement generally associated with the visits of the longer-tongued flies and the shorter-tongued hymenopterous insects.

The genus is wellnigh cosmopolitan, and our commonest and largest species, *A. Plantago-aquatica* L., is said to occur in Australia as well as throughout northern Temperate regions.

This species grows two or three feet high and its leaves are from six to eight inches long. The first-formed leaves are often submerged or floating ; but the later ascending ones have from five to seven longitudinal ribs, and vary considerably in the way in which the blade passes into the long stalk, tapering or rounded in a sub-cordate manner. The branches of its graceful panicle become more slender at each successive branching from the bluntly triangular main stalk, and the delicate little flowers are often suffused with a pale pink, while the yellow base or claw of each petal recalls the blossoms of the Water-crowfoots. Stamens and carpels mature simultaneously, so that self-pollination is not prevented ; and the carpels, which may number from twenty to thirty, are arranged in a ring and thus become laterally compressed.

IX.—THE ARROW-HEAD.

Sagittaria sagittifolia Linné.

THE beauty of this exquisite aquatic plant has attracted attention in many lands, apart altogether from its many points of botanical interest. There never could be any question as to an appropriate name to be assigned to it. In some of our early botanical books it is styled Water Archer, and Gerard says that it

"hath large and long leaves, in shape like the signe sagittarius, or rather like a bearded broad arrowe heade."

It is *Sagittaire* in French, *Pfeilkraut* in German, and *Pijlkruid* in Flemish; and the shape of the leaves might have been thought a sufficient reason, without the crude suggestion of the doctrine of signatures that "it is good to pull out arrows." The plant is cultivated in China for the sake of its edible tubers and is frequently represented on Chinese drawings and porcelain, sometimes in association with the buds or fruits of the sacred lotus or cyamus (*Nelumbium speciosum* Willd.). They form the "egg and anchor" ornament in architecture; and it has been suggested that as the egg-shaped buds of the *Nelumbium* are the emblem of fecundity, so the leaves of the Arrow-head may represent the contrary or destroying agency.

Botanically, the genus *Sagittaria* is nearly related to *Alisma*, differing mainly in having monœcious flowers and an indefinite number of stamens. It includes about a dozen species, mostly American, several of which are in cultivation, such as *S. heterophylla* Pursh and *S. montevidensis* Chamisso and Schlechtendal, as is also a large Chinese form, *S. sinensis*, sometimes known to gardeners as *S. gigantea* or *S. lancifolia*, probably specifically identical with our plant. They can be propagated by seed sown in pans of sand half submerged in water, or by division, advantage being taken of their characteristically *stoloniferous* habit. The main stem is a short rhizome from which all the leaves originate, that is, they are all what is termed *radical;* but from their axils spring the "renewal shoots," short branches that burrow into the mud and swell up at their apex into a globose starchy tuber or resting bud half an inch or more in diameter. These hibernating structures are the objects of the Chinese cultivation of the plant. In the spring they develop into new plants.

No plant shows a greater variety in the adaptation of its leaves in relation to the condition of the surrounding water as to depth and movement. Three kinds of leaf are produced, the number of each kind depending upon these conditions. Those which are entirely submersed are merely elongated, flattened, thin, and pellucid petioles, without blades and therefore, of course, destitute of the characteristic barbs, and frequently attributed by mistake to some kind of Pond-weed or *Potamogeton*. Their transparency is due not only to their thinness, but to a character that they share with most submersed leaves and others growing in shade, where the light is but scanty, viz. a relatively small number of granules of chlorophyll, or green colouring-matter, which place themselves along the walls of the cells so as to receive the maximum amount of light which is in this case much lessened by refraction.

Other leaves float on the surface and have an ovate or heart-shaped blade ; while the majority of the leaves are generally the more distinctively arrow-shaped ones which rise erect above the water. These are from two to eight inches long in the blade, the barbs being about half of this, and the stout, spongy, three-sided leaf-stalks varying from eight to eighteen inches or more in length, according to the depth of water from which they rise. The veining of these elegant glossy leaves is, it will be noticed, of a simpler type than that of the somewhat similarly shaped leaves of the Lords-and-ladies (*Arum maculatum* L.). The veins here are of but two degrees of coarseness and these sharply contrasted, the stout longitudinal ones converging towards the base and apex of the leaf, some of which bend round into the barbs or *auricles*, and the much finer obliquely transverse nervures ; whereas the *Arum* approximates to the Dicotyledons in the gradually diminishing coarseness of the veins at each branching, producing a network of far more irregular appearance. It will be readily understood that the variation of leaf-form with the surrounding conditions has given rise to the description of several so-called varieties.

The flower-stalk is similar to the leaf-stalk in texture and rises unbranched slightly above the level of the water, so that it too is from eight to eighteen inches or more in height. It bears from three to five whorls of blossoms, some little distance apart, with from three to five flowers in each whorl, the lower whorl being carpellate and having shorter flower-stalks, and those in the upper whorls more numerous, with slightly longer stalks, and staminate. The flowers are about half an inch across, but the upper (staminate) ones are larger than the lower (carpellate). The three ovate concave green leaves of the calyx persist in the fruit stage ; but, as is generally the case among the *Alismaceæ*, the large and conspicuous petals fall off early. They are three times as large as the sepals, rounded and white, and gradually spread out from a concave to a perfectly flat condition ; but their short *claws* or pointed bases are beautifully tinged with lilac.

The heart-shaped anthers of the stamens in the upper flowers are also of a violet colour, and the number of stamens, which is about twenty-four, lends some support to the opinion that the flowers are only visited by flies for the sake of the pollen and do not produce nectar. At the same time, the mere separation of stamens and carpels in distinct flowers making self-pollination impossible would necessitate the production of more pollen, much being inevitably wasted.

The carpels are also numerous, and, though compressed, form a head and not a ring as do those of *Alisma*. They are indehiscent and one-seeded, but swell out on their outer margins into a spongy wing containing a good deal of air and acting apparently as a float; whilst the polished seeds are not wetted by water, another character which probably aids in their dispersal.

The earliest record we have of this plant was from the Tower ditch, and not a hundred years have passed since it was growing not only in the ditches of Battersea Fields but even in the Thames itself near the Temple stairs.

X.—THE FLOWERING RUSH.

Butomus umbellatus Linné.

IT is only by relatively unimportant or inconstant characters that the small Family of the *Butomaceæ*, which takes its name from this beautiful water-plant, is separated from the larger Family *Alismaceæ*, the Water-plantains. The chief distinction is that in the *Butomaceæ* there are many ovules in each carpel, while in the *Alismaceæ* there are but from one to three. In both groups the smooth simple leaves rise, in most instances, from an underground stem; and in both the perianth is of six leaves, two alternating circles of three each, of which at least the inner three are petaloid in texture. The stamens are not less than six in number, though sometimes more, and are inserted under the carpels; while these latter are also either six or more in number, and are usually quite separate from one another.

The genus *Butomus* derives its name—a name that dates from Theophrastus in the fourth century B.C.—from the Greek *βοὺς*, *bous*, an ox, and *τέμνω*, *temno*, I cut, because the leaves of the plant to which this name was originally applied were apt to cut the mouths of cattle browsing upon them. The one species which constitutes the present genus takes its specific name of *umbellatus* from the umbel-like arrangement of its flower-clusters; but the English name Flowering Rush is most misleading in its suggestions, since the plant is by no means closely related to the true Rushes, while, though the flowers of those plants have not the conspicuous beauty of those of *Butomus*, they are just as truly flowers.

Our drawing is taken from a young plant; but at a later stage a creeping rhizome develops in the mud; and this is baked and eaten in Northern Asia. It has, when not cooked, acrid and bitter properties which led to its use in medicine in former times; but now the plant is valued only, as Gerard says, "because of the beautie and braverie thereof."

It will be noticed that the leaves, which are sometimes as much as four feet long and rise erect for some distance above the surface of the water, are triangular in section, like a rapier, and are sheathing at their bases; whilst the inflorescence is borne aloft on a stout cylindrical, or slightly tapering, stalk, which is also often two, three, or even more feet in length, so as generally to overtop the leaves at the time of flowering. It is remarkable that even the flower-stalk is often suffused with a tint of the red colour that characterises most of the floral organs, as if some warm blood were coursing through its veins. The head of flowers is enclosed at first by several thin membranous brownish bracts, each tapering to a slender point; and the arrangement of the flowers appears at first sight to be a simple umbel. On examination, however, it will be found that the first flower to open is a central terminal one, and that the rest form three cymes or branch-systems, with lateral branches given off in succession on the same side, each known technically as a bostryx.

There may be as many as twenty or thirty of the delicate blossoms in a cluster, each borne on an individual stalk or pedicel, two to four inches long; and showing in a striking manner that trimerous or three-parted symmetry which is typical of Monocotyledons. There is little or no difference between the three spreading oblong leaves of the outer perianth-whorl, or sepals, and the three inner ones, or petals, the fascinating blush of rosy pink of both whorls being exceptional in the Family. The same colour marks the anthers and the carpels, but in them it appears in a deeper shade. Unlike its ally the Arrow-head, *Butomus* has perfect flowers, each possessing both stamens and carpels; but this by no means implies that it is self-pollinating.

The presence of nine stamens in each flower is an uncommon character; but careful study reveals the fact that these nine consist of an outer whorl of three, each branching low down into two, placed side by side, as is also the case in the allied Water-plantains, and an inner whorl of three unbranched ones, which do not occur in the Water-plantains. The anthers split down their inner surfaces, *i.e.* towards the centre of the flower.

The carpels are also in two alternating whorls of three each, and are slightly united at their bases, where they exude a copious supply of nectar. Each of them is prolonged upwards into a short outward-bending style, which bears its stigma on its inner surface, the same surface as that along which the ripe carpel splits to discharge its seeds. It is remarkable that, as in the remotely-related Dicotyledonous Water-lilies, the numerous ovules are scattered over the inner surface of the carpels; and that, unlike most Monocotyledons, though in this resembling many other aquatic plants, the numerous resultant seeds are simple in construction, not retaining any food-store or albumen.

Observations show that the outer anthers ripen first and that all nine, sometimes at least, shed their pollen before the stigmas are ready to receive it; so that this species is usually cross-pollinated by the insects attracted to its conspicuous, sweet-scented, and honeyed blossoms. It may, in fact, be the plant known as Bee-wort in Early English times, though the identity of the plant so known is by no means certain. Fortunately its beautiful blossoms may still be seen in summer by many a slow river or by standing water.

In cultivation the plant is commonly increased by dividing the rhizome in spring; but it may also be grown from seed. For this purpose, ripe seeds should be sown in pans of sandy soil half submerged in water; and the seedlings may be pricked out into other pans of similar soil until large enough to be planted out on the edge of the water. If entirely submerged the plants are apt to increase and run to leaf; but they flower more freely, it appears, if their supply of water be slightly curtailed.

XI.—THE FROG-BIT.

Hydrocharis Morsus-ranæ Linné.

WE may take this opportunity of explaining, what we have hitherto neglected to mention, that the practice of botanists is, while writing the first or *generic* name of all plants with an initial capital whenever it is used, or abbreviating it to a single initial letter when several species of the same genus are mentioned in succession, to begin the second of the two names that every species bears—the *specific* name—with a small initial. To this latter part of the rule, however, there are exceptions, the specific name being written with a capital when it is the name of a person or when, as in *Hydrocharis Morsus-ranæ*, it is an old generic name.

This genus *Hydrocharis* gives its name to a Family, the *Hydrocharitaceæ*, the position of which in the classification we here adopt is the main distinction between the Order *Helobieæ* and the Cohort *Potamales* of that of Bentham and Hooker. By those authorities the Family was separated from those with which it is here associated, on account of its inferior ovary ; but, as in many other cases, this character is not nowadays allowed to outweigh other indications of affinity. The Family is not a large one, comprising as it does some fourteen genera and less than sixty known species ; but, like so many other groups of aquatic plants, it is widely distributed in almost all climates, and it includes several of the few genera of flowering plants that live in sea-water. They are all herbaceous, mostly perennial, and either submerged, with ribbon-like leaves, or floating. Their leaves vary considerably, being sometimes cauline, whorled, or rising above the water, sometimes toothed at the margin, and sometimes reduced to a flattened petiole or *phyllode ;* but they have "squamulæ intravaginales" and produce stolons from axillary buds, of which there are often more than one in an axil. Like many other aquatics, they multiply largely by such purely vegetative methods as these stolons, either not flowering freely or not producing fertile seed. Their flowers are mostly diœcious, though conspicuous, and are enclosed, in the bud stage, in a sheath or *spathe*, a structure common to many groups of Monocotyledons, but not a safe indication of affinity in the absence of other characters common to the presumed allies. The perianth, consisting of six leaves in two whorls, of which the outer is calyx-like and the inner petaloid and more conspicuous, resembles that of the *Alismaceæ ;* but differs markedly in being epigynous or superior. The stamens are three to fifteen in number, in alternating whorls or three each, some of them being sometimes aborted and all of them often slightly united at their bases, as in some of the allied types that we have just described, but attached to the segments of the perianth (*epigynous* and *epiphyllous*). The carpels are, perhaps, never less than two, often six, and sometimes as many as fifteen, forming a one- or more-chambered ovary, surmounted by bifurcating stigmas and having *parietal placentation*, *i.e.* the ovules attached to the outer wall of the ovary. The fruits ripen under water, split open irregularly as they decay, so liberating the seeds, which are

exalbuminous and enclose straight embryos. It should, perhaps, be here pointed out that the staminate flowers contain a rudimentary, or rather vestigial, ovary ; and, conversely, the carpellate flowers have aborted stamens, a clear indication that this diœcious condition is not primitive but the result of a process of degeneration.

The Frog-bit is a monotypic genus, a genus, that is, consisting of but a single species, and this species is native to Northern Asia and Europe. Growing, like many species of *Ranunculus*, in situations that are the haunts of frogs, the fancy of our ancestors seems to have supposed it to owe the heart-shaped base of its floating leaves to the bite of a frog, as is also expressed in the old generic name, from the Latin *morsus*, a biting, *ranæ*, of a frog, which dates back to Rembert Dodoens in the sixteenth century. To avoid this two-worded name, Linnæus renamed it *Hydrocharis*, from the Greek ὕδωρ, *hudor*, water, and χάρις, *charis*, delight.

Floating on the surface of still waters, it neither requires nor possesses much that can be called a main stem, its "radical" leaves springing in a rosette from a most abbreviated axis. They are leathery in texture, round, obtuse, a reddish purple on their under surfaces, and from an inch to an inch and a half in diameter. The reddish under surface may, like that of many of the low-growing plants in the dense forests of the Tropics, be a means of converting the incident rays of light into heat, or may possibly serve also as a protection against fish. As is the rule with such leaves, the petiole retains the power of elongation by intercalary growth, and the stomata, or transpiration-pores, are confined to the upper surface. It is an interesting experiment to drive air or to draw water through these apertures by immersing the blade under water and blowing or sucking through the leaf-stalk with the mouth.

From the base of the axis several slender transparent roots descend into the water, serving, perhaps, in part, like those of the Duck-weed, to prevent the plant from being blown over in the water, but furnished with numerous delicate root-hairs. The circulation of the protoplasm in these affords a striking study for the microscopist.

Most of the buds forming in the axils in summer develop into horizontal stolons, much as do the runners of the Strawberry, with new plants at their ends ; but in autumn large buds form on these stolons, become detached and sink to the bottom, where they hibernate in the mud, floating to the surface in spring and developing into new plants.

The delicate white petals have a yellow base, with a fleshy nectariferous gland, thus resembling those of many other unrelated aquatic plants which are pollinated mainly by flies.

There are generally three whorls of stamens with broad fleshy filaments and connectives, those of the middle whorl having a long club-like appendage ; and there are six united carpels with styles separating and bifurcating above.

The numerous, minute, roundish seeds have a very remarkable testa of cylindrical cells with a spiral thickening which they emit when moistened.

XII.—LORDS-AND-LADIES.

Arum maculatum Linné.

IT is not surprising that this remarkable plant, common as it is and widely dissimilar from all other British plants, should have attracted much attention from very early times. We shall not here be able to deal with a tithe of the popular names it has received.

The great Family *Araceæ* to which it belongs, comprising upwards of a hundred genera and a thousand species, is very largely tropical. Many of them grow as epiphytes on the boughs of trees in moist Equatorial forests: others have large starchy underground stems. Many are acrid or poisonous, though in some cases the deleterious properties may be dissipated by heat. A sagittate leaf with complex reticulate venation commonly, but by no means always, occurs; and the flowers are usually massed together on a fleshy cylindrical spadix and enclosed in a large sheathing bract or spathe. The fruit is a berry.

There are two British species of *Arum*, closely similar; but *Arum italicum* Miller is rather larger than the commoner species and is confined to our southern coasts.

Arum maculatum L. has an annual starchy corm or premorse rhizome, formerly used in starching linen, and, not very long ago, as food, under the name of Portland arrow-root. From it spring the glossy, hastate leaves, with sheathing bases and often spotted with purple, whence the name *maculatum*. In some places, however, the leaves are not so spotted, and the meaning of these spots, or of their absence, is as yet unknown. The leaves are full of needle-like microscopic crystals, which prick the tongue and so produce some at least of the sensations of a pungent irritant.

In April, at the season when the cuckoo arrives, and rather in advance of the leaves, the scape rises from the corm swathed round with the pallid yellowish spathe. This spathe reaches a height of from six to ten inches and is borne erect, tapering to a slender apex. At about a quarter of its height it is contracted so as to form an ovoid basal chamber, while the upper three quarters so unfolds as to disclose the upper extremity or *appendix* of the spadix. The spathe is often edged, spotted, or blurred at the back with purple; and, as in all Aroids, just before it unfolds, the rapid formation of floral structures in the basal chamber is accompanied by so considerable an evolution of heat that the temperature within the chamber is markedly in excess of that of the external air. The flowers are confined to the basal portion of the spadix, the club-shaped appendix being filled with starch and a reddish-purple or yellow colouring-matter. These two varieties are apparently the "lords" and "ladies" respectively of country children. Though in a much less degree than many related exotic forms, this species, especially the luridly purple variety, gives off a fetid, carrion-like smell, which is attractive to flies, as perhaps also is the warmth within the hollow base.

The flowers are monœcious and are entirely destitute of a perianth, being each reduced to a single stamen or to a one-chambered ovary. On the fleshy peduncle, within the basal chamber of the spathe, the carpellate flowers are the lowest, a spirally-arranged, closely-packed series of yellowish ovaries, surmounted by sessile stigmas. A little above these are a few barren structures, apparently ovaries with styles but without stigmas. Above these again is a close-set band of purplish sessile anthers opening at the apex of their pollen-chambers. Lastly, just in the narrow throat of the constriction, where the spadix narrows before expanding into the club-shaped appendix, is a band of other hair-like aborted structures, probably staminodes.

"In this case," wrote the late Lord Avebury, "nothing would at first sight seem easier or more natural than that the pollen from the anthers should fall on, and fertilise, the pistils. This, however, is not what occurs. The stigmas mature before the anthers, and by the time the pollen is shed, have become incapable of fertilisation. It is impossible, therefore, that the plant should fertilise itself. . . . Small flies, attracted by the showy central spadix, the peculiar smell, the prospect of honey, and perhaps of shelter, enter the tube while the stigmas are mature, and find themselves imprisoned by the fringe of hairs, which, while permitting their entrance, prevents them from returning. After a while, however, the period of maturity of the stigmas is over, and each secretes a drop of honey, thus repaying the insects for their captivity. The anthers then ripen and shed their pollen, which falls on and adheres to the insects. Then the hairs gradually shrivel up and set the insects free, which carry the pollen with them, so that those which visit another plant can hardly fail to deposit some of it on the stigmas."

This explanation has, however, been much criticised by the late Father John Gerard, who points out that the "hairs" or staminodes are not stiff or sharp, do not always point downwards, do not extend as far as the walls of the chamber, are some distance apart, and do not, as a matter of fact, prevent the egress of all the insects. He suggests that the *Arum* is not so protogynous that self-pollination is impossible, and that the little flies, of which as many as four thousand have been counted in one spathe, are drugged by the plant to a state of imbecility and are ultimately digested, only wings and other indigestible parts of them remaining. It is suggested that it is the nectar secreted by the stigmas which produces this fatal anæsthesia.

The upper part of the spathe withers, the starch of the appendix goes to nourish the swelling fruits and seeds, and in summer the ovaries, which have then become glossy green berries half an inch each in diameter, burst through the basal chamber and gradually turn to a brilliant scarlet. These fruits are slightly succulent and each contains two or three seeds, the surfaces of which are covered with a network of ridges. As if Father Gerard's story was not sufficiently gruesome, Mr. Grant Allen actually suggested that these berries, which are certainly poisonous to human beings, also proved fatal to birds, thus ensuring manure for the sprouting seed; but for this hypothesis there is no evidence whatever.

In his "Names of Herbes" (1548)—the earliest record of Lords-and-ladies as a British plant—William Turner writes :—

"Arum is called in greke aron, in englishe Cuckopintell, Wake Robin, or Rampe, in duche Pfaffen bynde, in frenche Vidchaen, the Poticarie calleth it Pes vituli, Serpentaria minor, Luph minus groweth in euery hedge almost in Englande aboute townes in the spryng of the yere."

XIII.—GOOD-FRIDAY GRASS.

Luzula campestris De Candolle.

TO those who have not paid much attention to the structure of flowers there will not appear much similarity between a Rush and a Lily; but when we make a scientific scrutiny of their comparative anatomy we find that they cannot be very widely separated in any classification based upon floral structure. Accordingly we have an Order *Liliiflorae* which comprises nine Families, of which five are represented in our British flora, viz. *Juncaceae*, *Liliaceae*, *Amaryllidaceae*, *Dioscoreaceae*, and *Iridaceae*. The general characters which these Families have in common are the possession of flowers which are usually polysymmetric and trimerous, with fifteen floral leaves in five circles of three each, ovules inverted as they develop (*anatropous*), and a fleshy or cartilaginous food-store or "albumen" in the seed. The two perianth-whorls may be alike or unlike one another, membranous or dry (*glumaceous*), or petaloid, and occasionally the whole symmetry is tetramerous or pentamerous, that is to say that there are four or five parts in each whorl instead of the usual three. Though there are normally two circles of stamens, the inner circle is sometimes absent.

It must be admitted that the name *Juncaginaceae*, which their rush-like habit has obtained for the small Family, of which the Arrow-grasses (*Triglochin*) are examples, is somewhat confusingly like *Juncaceae*, the name of the larger Family to which the Rushes and Wood-rushes belong.

The latter Family comprises some seven genera and two hundred species, mostly inhabitants of damp and cold places in Temperate or Polar lands. They are mostly perennial herbaceous plants, with a creeping scaly rhizome branching sympodially, one branch rising annually above ground as a leafy shoot.

The leaves are usually narrow and slender and may be flat, as in the Wood-rushes (*Luzula*), cylindric and tapering or *centric*, as in most Rushes, or reduced to sheathing scales.

The distinctively brown, glumaceous, wind-pollinated flowers are usually crowded together in tufted cymes, with a somewhat complex, unilateral branching; but, in spite of their small size and inconspicuous character, they are generally both complete and perfect, that is, they have a perianth of two whorls, although both are calyx-like, and both stamens and carpels occur in each flower, a character which distinguishes them from the Sedges (*Carex*), a group often growing side by side with them. The perianth persists in the fruit stage.

The six stamens are generally attached to the bases of the perianth-leaves and their long linear anthers, which burst inwards and longitudinally, are attached to the flattened filaments by their bases, as in Sedges, not being versatile and *dorsifixed* like those of Grasses. The three carpels are united into an ovary, which may be three- or one-chambered and becomes a dry capsule; and they are surmounted in the flower-stage by a single style dividing into three remarkable stigmas each with a spirally

coiled receptive surface. As is the rule in wind-pollinated flowers, the stigma usually reaches its maturity or receptive state before the stamens are ready to discharge their pollen, and it may remain viscid for a few minutes, for a few hours, or for several days. It has also been observed that in this Family there is a marked tendency for many flowers to open simultaneously, without any apparent change in the weather to account for it—an arrangement obviously advantageous to anemophilous species.

The ancient name *Juncus* is connected with the Latin *jungere*, to join, the leaves of Rushes having from primitive times been used for tying ; and at one time the Wood-rushes were named *Juncoides*. They are distinguished by their flat grass-like leaves fringed with long, weak, white hairs, and by their one-chambered, three-seeded ovary. When the great Swiss botanist Auguste De Candolle founded the genus *Luzula*, the purist Sir James Edward Smith, the founder of our Linnean Society, essayed to make what he termed

"an indispensable correction in the orthography of the name. The hairy heads of flowers, wet with dew, and sparkling by moonlight, gave the elegant Italians an idea of their *lucciole*, or glow-worms ; sometimes written *luzziole*, but this is a provincial corruption. Hence, however, John Bauhin got the name of *Gramen luzulæ*, or Glow-worm Grass, for he never called it *Luzula*, which would have been the same as actually calling it a Glow-worm."

Smith accordingly calls *Luzula* "neither Latin nor good Italian" and spells the name *Luciola ;* but in this he has not been followed by other botanists.

The name Wood-rush is not very apt, since many of the forty species inhabit open pastures, fens, or mountain summits. *L. campestris*, coming into flower early in the year, often in March, and growing in meadows and pastures, though generally then only four or five inches high, is rendered conspicuous by its tufts of dark brown, or almost black, flowers, which are clustered three or four together in a three- or four-branched panicle. It has thus gained the names of Chimney-sweeps, Sweeps' Brushes, Smuts or Blackcaps, while its early flowering gives it that of Cuckoo-grass ; but from a variety of names, mostly quite local, I have selected one, Good-Friday Grass, in use in my native village.

This species is further distinguished by its creeping not tufted habit of growth, by a reddish-brown tinge at the base of its slightly lustrous leaves, by the filaments being less than a quarter the length of the anthers, and by the nearly globular brown seeds, one-twelfth of an inch in diameter, with a whitish basal appendage nearly half their length.

"As soon as the bud begins to open," writes Lord Avebury, "the three stigmas push out, and soon wither. Several days (5-9) then elapse before the flower is completely open, and another, making 6-10, before the anthers are ripe. The flower remains fully open for about 36 hours. From the long interval between the withering of the stigmas and the ripening of the anthers, it is evident that the flower can never fertilise itself."

XIV.—ANALYTICAL DRAWINGS OF MONOCOTYLEDONS I.

THE nine species analysed in this Plate are Monocotyledons of comparatively simple structure, though it is doubtful in many cases whether this simplicity is primitive or whether it is the result of degeneration.

Protected by their watery environment from crawling insects that might rob them of their honey, they do not, as a rule, produce hairs on their surfaces ; while those that have a conspicuous corolla have their petals usually white, white and yellow, or white tinged with pink. This seems to be a primitive type of floral colouring ; but it also appears to be peculiarly attractive to those insects that hover over the surface of water.

In several cases there are more than three carpels in the flower and there is no cohesion between them. This is unlike the main type of Monocotyledons in which there are three united carpels : it is a character at once primitive and of great interest in tracing the *phylogeny*, or ancestral history, of plants, since it is one of several characters suggesting the relationship of these humbler Monocotyledons to Dicotyledons.

These nine species comprise representatives of four of Engler's Orders, viz. *Pandanales*, *Helobieæ*, *Spathifloræ*, and *Liliifloræ ;* whilst they are referred to no less than five out of the seven "Series" into which Monocotyledons were divided by Bentham and Hooker. Thus the Families *Typhaceæ* and *Aroideæ* belong to their Series *Nudifloræ*, named from the more or less complete absence of a perianth ; the *Juncagineæ*, classed under *Naiadaceæ*, and the *Alismaceæ*, represented here by two plants, the Water-plantain and the Arrow-head, come in the Series *Apocarpeæ*, with the character, to which we have just referred, of generally more than three distinct carpels ; the *Hydrocharitaceæ* are in the Series *Microspermæ*, with a corolla, but with very minute seeds ; the *Juncaceæ* belong to the Series *Calycinæ*, with a sepaloid perianth ; and *Narthecium* represents the *Liliaceæ*, a Family of the Series *Coronarieæ*, with a corolla. Of these Series two—the *Microspermæ* and the *Apocarpeæ*—have exalbuminous seeds, an exceptional character among Monocotyledons, pointing, perhaps, to degeneracy. These two Series are united by Engler in his Order *Helobieæ*.

The Order *Pandanales* has spherical or cylindrical inflorescences of unisexual flowers, with little or no perianth, but with albuminous seeds. They are mostly, like our two representatives of the Order, water-side plants.

The Reed-mace, now commonly known as the Bulrush (*Typha latifolia* Linné) has a cylindrical head of closely-packed flowers, the tapering apex of which is composed of staminate flowers, one of which is shown in the first figure in the first row on our Plate. Fig. 2 is the same enlarged. The lower part of the cylindrical flower-head is made up of carpellate flowers packed together in a brown velvety mass. The third figure is one of these ; Fig. 4, the same enlarged ; and Fig. 5, the solitary, albuminous seed in longitudinal section.

The Branched Bur-reed (*Sparganium erectum* Linné) has spherical flower-heads. Fig. 1 in the second row on our Plate represents a staminate inflorescence ; Fig. 2, a single staminate flower with three stamens ; Fig. 3, a single stamen ; Fig. 4, a section through a carpellate flower-head ; and Fig. 5, a single carpel.

The Arrow-grass (*Triglochin palustre* Linné), occupying the third row on the Plate, represents the Family *Juncagineæ*, and, with the four following types, belongs to the varied aquatic Order *Helobieæ*. Fig. 1 is one of its perfect, anemophilous, protogynous flowers ; Fig. 2 is its gynæceum ; Fig. 3, the fruit ; Fig. 4, the same, showing its characteristic dehiscence ; and Fig. 5, the same in transverse section.

The Water-plantain (*Alisma Plantago-aquatica* Linné), in the fourth row on the Plate, and the Arrow-head (*Sagittaria sagittifolia* Linné), in the fifth, belong to the Family *Alismaceæ*, whilst the Flowering Rush (*Butomus umbellatus* Linné) is the type of the nearly allied *Butomaceæ*. Fig. 1 in the fourth row is a flower of *Alisma ;* Fig. 2, its essential organs ; Fig. 3, the calyx and carpels ; and Fig. 4, the same as seen from above.

Fig. 1 in the fifth row is a flower of the Arrow-head, as seen from below ; Fig. 2, one of the stamens dehiscing ; Fig. 3, the calyx and carpels ; Fig. 4, the same in longitudinal section ; and Fig. 5, a single carpel.

Fig. 1 in the sixth row is a flower of the so-called Flowering Rush, as seen from above ; Fig. 2, as seen from below ; Fig. 3, a stamen ; Fig. 4, a carpel ; Fig. 5, the same in section ; Fig. 6, the ripe fruit, a ring of follicles ; and Fig. 7, a transverse section through it.

The seventh row of figures represents the Frog-bit (*Hydrocharis Morsus-ranæ* Linné), Fig. 1 being a staminate flower, as seen from above ; Fig. 2, the same in section ; Fig. 3, a stamen ; Fig. 4, a stamen showing its "barren" or non-antheriferous branch ; Figs. 5 and 6, stigmas opposite to the sepals and to the petals respectively ; Fig. 7, the fruit ; Fig. 8, the same dehiscing ; and Fig. 9, a transverse section of it.

The eighth row of figures represents the singular inflorescence of the Lords-and-ladies (*Arum maculatum* Linné). Fig. 1 shows the entire spadix, and Fig. 3, the same in a later stage. Fig. 2 is a stamen dehiscing ; Fig. 4, an ovary, both stamens and ovaries each constituting an entire flower ; Fig. 5 is a side view of the same ; Fig. 6, a fruit seen in section ; Fig. 7, a seed ; and Fig. 8, one in section, showing embryo and albumen.

The Wood-rush (*Luzula campestris* De Candolle), represented in the last row of figures, belongs to the Rush Family (*Juncaceæ*). Fig. 1 shows one of its wind-pollinated flowers ; Fig. 2, the same enlarged ; Fig. 3, the gynæceum enlarged ; Fig. 4, a transverse section of the same ; and Fig. 5, a fruit after bursting, also enlarged.

XV.—THE BOG ASPHODEL.

Narthecium ossifragum Hudson.

FULL justice is done to the first vernal beauties of the year : in the height of summer, among many competing favourites, some may readily be overlooked ; and when autumn begins to be chill on bleak moorlands, fewer people are rambling about out of doors on the look out for the charms of Nature. Thus it is, perhaps, the situations in which it grows and its season of flowering and fruiting which have deprived the Bog Asphodel of what we consider its fair meed of praise.

It is the only British representative of a small group of genera, appropriately named *Xerotideæ* (from the Greek ξηρὸς, *xeros*, parched), on account of their usually dried-up or *xerophytic* appearance, which were formerly classed in the *Juncaceæ*, but are now looked upon as a Tribe of *Liliaceæ*. Their xerophytic character has been explained, in the case of *Narthecium*, as due to the coldness of the soil in which they grow, so that, though water is abundantly at hand, its absorption by the roots is checked. This explanation might apply to the upland bogs in which this plant, which grows as far north as the Shetland Islands and at altitudes of nearly 3,200 feet in the Highlands of Scotland, is often found ; but the main factor influencing it is, perhaps, rather the acid character of the stagnant peat which can be tolerated by but few plants, such as the Cotton-sedges (*Eriophorum*), some Bog-mosses (*Sphagnum*), and the Sundews (*Drosera*), which are the usual associates of the Bog Asphodel. Plants capable of living under these acid conditions have been termed *oxylophytes*. Probably the humus acids in the peaty soil reduce their root-action, so that, wet as it is, such soil has been described as "physiologically dry."

There are but four species in the genus *Narthecium*, all of them natives of the North Temperate Zone. Our British species does not occur to the south of the Alps and Carpathians.

In many points its structure is certainly very closely related to that of the Rush Family, and some of these are characters that do not seem merely parallel adaptations to similar conditions but suggest affinity. There is a long, slender, wiry rhizome, with leaf-scales and a sympodial branching, from which the aerial stem rises, and a tuft of narrow, rigid, strongly-keeled equitant leaves, which might well belong to Rush or Grass. The flowering stem rises erect and rigid, some six or eight inches, twice the height of the leaves, and to this, apparently, the genus owes its scientific name (from the Greek νάρθηξ, *narthex*, a wand). Its upper half is thickly set in July and August with the golden star-like blossoms, each shortly stalked, a lanceolate bract below each pedicel and equalling it in length, and generally a smaller bracteole midway on the flower-stalk. The six petaloid perianth-leaves, which are pointed and linear-lanceolate in form and have membranous edges, spread widely into a flower half an inch across ; but afterwards close round the base of the capsule, their permanence being another Rush-like character ; and, golden as they are above,

each has a green keel down its under surface. The six stamens have subulate white filaments, covered for most of their length with long woolly hairs; and scarlet or orange, linear, dorsifixed anthers, which burst inwards, curl up spirally and wither, while the filaments, like the perianth-leaves, remain into the fruiting stage. The narrow oblong ovary rises to twice the height of the convergent perianth-leaves. It is bluntly three-angled and tapers above into a short style surmounted by a simple stigma. This becomes receptive at the same time as the stamens burst, so that the flower may be often self-pollinated; but, though it produces no honey, it has a delicate fragrance and is visited by insects for the sake of its pollen and may thus also be cross-pollinated.

Attractive as are the blossoms of the Asphodel in July, the plant is far more striking when in fruit, when its erect elongated capsules are borne aloft above the black peaty soil of the moorland like living flames of yellow, orange, and red. Ultimately they split open in three valves from above downwards, liberating the numerous remarkable little seeds.

These arise from near the base of the three chambers of the capsule and the body of the linear yellow seed itself is not more than a millimetre in length; but it is attached by a slender thread-like stalk or *funicle*, eight or nine times as long, and its outer coat tapers at the other extremity into an equally long hair, so that the whole structure is as long as the chamber in which it is enclosed, nearly an inch, that is to say. Attention may be called to the fact that the brilliant display of colour in the fruit of the Asphodel is, like that of autumn leaves, a chemical change in the chlorophyll, which is not apparently in any way connected with seed-dispersal. The capsules cannot be termed fleshy, and we have never heard of their proving attractive as food to birds or other animals.

Some of our earlier botanists called this plant the Lancashire Asphodel, and Lobel stated that it was known in that county as Maiden-hair, because maidens used it to dye their hair yellow. Its specific name *ossifragum*, *i.e.* bone-breaker, it owes to the belief that it caused a softening of the bones and rot in cattle and sheep feeding upon it, the truth being that this disease is produced by a parasitic worm or "fluke," which passes part of its life-history in a pond-snail inhabiting the wet ground where *Narthecium* grows and part in the liver of sheep or cattle. The plant is, therefore, as Linnæus long ago insisted, entirely innocent in the matter.

It is, as we have seen, generally found on very wet peat-bogs or heaths, and not in meadows or other ground occupied by the social grasses; therefore, so far as this species is concerned, we cannot hope to be among

> "those happy souls who dwell
> In yellow mead of asphodel."

XVI.—THE MEADOW SAFFRON.

Colchicum autumnale Linné.

THE Family *Liliaceæ* is one of the largest in the Vegetable Kingdom, comprising as it does some 2,500 species in 200 genera. Most of them are perennial herbaceous plants, though a few in warmer regions are arborescent. Many of them have bulbs or other fleshy forms of underground stem and some are succulent, the Family comprising many forms adapted to the warmer dry regions of the globe. Their flowers are usually perfect, polysymmetric, pentacyclic, and trimerous, consisting, that is, like those of the closely allied *Juncaceæ*, of five whorls of three leaves each, the most striking difference between them and those of the *Juncaceæ* being that their perianth consists of two petaloid whorls, whilst, as we have seen, that of the Rush Family is sepaloid. Honey is commonly secreted, and cross-pollination is usually effected by insect agency. The three carpels are usually united into a superior ovary with three chambers containing numerous ovules, in two rows in each chamber, springing from a central or axile placenta : the ovules are inverted or anatropous, and the ripe seeds contain fleshy or cartilaginous, but never mealy, albumen.

Though including many plants of the greatest beauty, the ornaments of our gardens and greenhouses, the Family is not so rich in plants of economic value. The Asparagus and the Onion group are the chief food-plants in the Family : New Zealand Flax and Sisal Hemp are important fibres ; and Aloes, Squills, Sarsaparilla, and Colchicum are its chief medicinal products.

The genus *Colchicum* comprises some thirty species, natives of Europe, Western Asia, or Northern Africa, our British species not occurring wild to the north of England and Denmark. The striking life-history in which the foliage and fruit appear at a season markedly distinct from that of flowering has naturally resulted in more notice being taken of the plant in the latter, that is in the autumn, season, as is evidenced by the specific name *autumnale* and by some of the less familiar popular names, such as Upstart or Son-before-the-father.

The underground stem is a solid corm enclosed in a thick chestnut-brown sheath, the withered remains of the lowermost foliage-leaf of the previous year. During the spring this corm enlarges considerably as food is stored in it by the physiological activity of the large radical leaves that then unfold. A bunch of unbranched root-fibres springs from the base of the corm, and within the brown outer sheath there are three sheathing leaves the internodes between which do not elongate. Two of these remain as sheaths, but the third develops a blade and forms the first foliage-leaf to rise above ground. The internode next above it is the enlarging corm, whilst an axillary bud will form later to constitute the corm of the following year. Above the thickening internode rise two more foliage-leaves and a series of leaf-scales, in the axils of which the flower-buds will originate ; and

the shrivelled remains of the now emptied corm of last year will be seen attached laterally to one side of the new corm which has sprung from it, but at a somewhat higher level, each succeeding year carrying the plant slightly deeper into the ground.

There are thus generally three radical foliage-leaves. They reach a foot or more in length and about an inch and a half in width, having an oblong-lanceolate outline, the entire margin common among Monocotyledons, closely-set parallel veins, the midrib forming a slight keel, an obtuse apex, a smooth surface, and a dark green colour. Rising nearly erect, they show but little colour-contrast between their two surfaces.

As the corm enlarges, the other internodes of the stem elongate, so that the fruits of the flowers of the previous autumn which have formed underground are now carried up to ripen in the summer sun. It has been suggested that this is an advantage to the plant, since, flowering so late as it does in autumn, it would not have time to ripen its fruit, if remaining above ground, before the frosts of winter.

In September and October three or four flowers rise in succession from the arrested apex of the stem ; and, although the foliage is, as will have been seen, more like that of a Tulip than that of a Crocus, the close resemblance of these flowers to those of the latter genus have naturally given to the plant the names of Autumn Crocus and Meadow Saffron, both of which are misleading. The slender, pale, angular perianth-tube rises from two to six inches above the ground, ending in two whorls of elliptical concave pointed segments, about an inch and a half in length, but the inner circle slightly shorter than the others. The flowers may be lilac or white ; and we have noticed on the slopes of the Long Knoll at Maiden Bradley, on the borders of Wilts and Somerset, that whole fields were of one colour or the other, as if spreading in each case from one centre. The perianth-leaves elongate while the flower is open.

Concealed within its bell-like cup and slender tube are the characters that distinguish *Colchicum* from *Crocus ;* for here we have six stamens, instead of the three in *Crocus ;* and, though the ovary is underground, at the bottom of the long perianth-tube it is superior, free, that is, from all adhesion to the tube, which is not the case in *Crocus*. The yellow anthers are versatile, but burst outwards, and they are not mature until after the stigmas. Honey is secreted by the bases of the filaments, which are woolly. Three separate slender styles rise from the ovary to the summit of the flower, ending in recurved simple stigmas, quite unlike those of *Crocus*, which constitute saffron ; and there seem to be three different lengths of style in different individuals, as in the Purple Loosestrife, an arrangement probably connected with insect-pollination.

The large elliptical three-sided capsule splits open at the top and discharges numerous minute seeds.

XVII.—RAMSON.

Allium ursinum Linné.

IT has been truly said of this species that, if we could only divest it of its evil smell, it would rank among the most attractive of our British plants. Its leaves are very similar to those of the Lily-of-the-valley, and its starry flowers are of the purest white ; but it cannot be gathered, and it often so carpets the ground in oak-woods on a moist clayey soil that one cannot avoid stepping upon it and bringing out its fetid odour.

The rank pungent taste and smell that pervade the stems and leaves of all the species of the large genus *Allium* result from a volatile essential oil, which is rich in sulphur and apparently occurs also in at least one member of the Family *Cruciferæ*. This probably gives to the various esculents of the group—onions, leeks, garlic, chives, shallots, etc.—some slight medicinal value in addition to their merely appetising action as flavouring. Many of them have been in cultivation from at least 3000 B.C., so that it is doubtful if they are known in a truly wild state ; and we read not only of their having formed the daily food of the labourer in Ancient Egypt, but of their having in that country received almost divine honours. Popular as these strong flavours are, especially among the southern Latin races, it would seem that persons of refined taste have always held aloof from them, from Horace to Mahomet. According to Mohammedan legend :—

> "When Satan stepped out from the Garden of Eden after the Fall, Garlic sprang up from the spot where he placed his left foot, and Onions from that which he touched with his right foot, on which account, perhaps, Mahomet always fainted at the sight of either."

There are about 250 species in the genus, all of them natives of the North Temperate Zone ; and as all of them are bulbous plants they are especially characteristic in most cases of dry and warm soils. It is not without significance in this connection that, while many of the species have the familiar centric and glaucous leaves characteristic of xerophytes, this species, which inhabits moist shady situations, has the broad, flat, sub-erect leaves which are common to several other plants growing in similar habitats.

The bulbs of *Allium ursinum* are slender and oblong and have a fibrous white outer coat. From them rise naked triangular stems, their bases sheathed by those of the stalks of two leaves. These leaf-stalks are from two to four inches long, while the blades of the leaves are twice as much.

The inflorescence, although umbellate, is cymose, central flowers opening first ; but the way in which it is rendered more conspicuous by all the flowers being brought to one level is well exemplified in this species. The flower-head is enclosed in two ovate-acuminate spathes, each about an inch in length ; but there are none of the little bulbils among the flowers which occur in several related species. The six narrow-pointed perianth-leaves spread

widely, and the six slender stamens are each slightly attached to the base of a perianth-leaf. The three inner stamens mature and burst their anthers before the stigma becomes receptive : then the style grows to double its length ; and finally the three outer anthers burst. Nectar is secreted by glands situated between the three lobes of the ovary and the flowers are visited by bees and flies ; but by this arrangement, if cross-pollination is not effected, self-pollination is possible. The fruit is a small three-lobed top-shaped capsule.

An interesting study of this species has been made by Mr. G. F. Scott-Elliot in connection with the manner in which the bulbs bury themselves. The seeds, he explains, sprout on the surface of the ground ; but the elongation of the petiolar region of the cotyledon carries the rudimentary radicle and plumule three or four millimetres below the surface. Bulbs seem in this, as in most cases, to originate in a fleshy concave enlargement of the base of the cotyledon with other early-formed leaf-bases enclosed within it.

"In April a circle of peculiar fleshy roots is formed : they grow obliquely downwards, and when they are firmly fixed by root-hairs at their ends, they contract, losing about 30 per cent. of their original length : in so doing they draw the bulb downward into the soil."

A similar phenomenon may be observed in the roots of Hyacinths when grown in a glass : as they increase in thickness they shrink in length, so that their surface becomes covered with transverse wrinkles.

From May to July, Mr. Scott-Elliot continues, the green leaves are doing their work, and the tiny bulblets are much enlarged by the food stored up in them.

"In September another series of roots grows, not downwards, but outwards : these are thin, they have no power of contraction, and simply absorb nourishment like those of ordinary plants. From November to April is the winter rest, and in April another circle of stout contracting roots is produced, which again drag the bulb downwards. Eventually it comes to lie at a depth of 10-15 centimetres." (4-6 inches.)

Whilst on account of its usual habitat it has been called "Wood Garlic," it grows also in the well-shaded depths of the grykes or fissures in what are known as "limestone-pavements" in Ireland and in the north of England. Its scientific name has been translated "Bear's Garlic," as to which Sir James Edward Smith has the delightful remark :—

"Pliny, who first has recorded the specific name, does not account for its application. The coarseness of its qualities, like the manners of some human beings, may, in both cases, justify the comparison."

Smith has, however, overlooked a remark by the herbalist Jacob Theodor of Bergzabern (who styled himself Tabernæmontanus, and who, living in the sixteenth century when bears were more abundant in Europe than at present, may have known more about their tastes) to the effect that bears delight in this garlic.

As to the name *Ramson*, it is apparently the plural of *Ramse*, a Scandinavian equivalent for our word *rank*, with reference to the smell and taste of the plant.

XVIII.—THE FRITILLARY.

Fritillaria Meleagris Linné.

CONSIDERING how conspicuously beautiful this species is, and how abundant it is in the localities in our south-eastern counties where it is wild, it is strange that it should not have been definitely recorded as a British plant until the eighteenth century. Many—though, perhaps, not all—of its numerous popular names being clearly corruptions of book-names are also undoubtedly of recent origin, and some of them well exemplify the stages by which misunderstood appellations are phonetically transmuted or ignorantly misapplied.

It has a small, roundish, lobed bulb of two or three thick scales, from which the slender tapering aerial stem rises for nearly a foot. It is very rarely branched and bears, chiefly towards its upper part, a few scattered, slightly glaucous, linear leaves, six to eight inches long, from a quarter to half an inch in width, channelled and pointed.

The flower-bud stands erect; but, before opening, the solitary terminal bell-shaped or Tulip-like flower hangs inverted from an arched stalk. The six perianth-leaves are narrow, oblong, about an inch and a half long, pointed, with slightly inflexed points. They are commonly finely chequered in alternating squares of pink and a deep dull crimson; and similar chequering, though not universal in the genus, being, for example, absent in the familiar Crown Imperial (*Fritillaria imperialis* L.) of our gardens, occurs in other species. In the Kennet meadows above Reading a white variety is almost as abundant as the red, and a faint chequering is discernible through the white of the perianth-leaves.

Within the bell, near the base of each perianth-leaf, is a nectary, which, in the British species, is narrow and linear; but the flower is scentless. The six stamens are attached to the bases of the perianth-leaves, below the nectaries; they have subulate filaments and yellow introrse anthers about half an inch long which do not mature until after the stigmas. The three carpels are united in an oblong, three-lobed and three-chambered, superior ovary, closely packed with a double row of ovules in each chamber, springing from the central placental axis. There is a single, three-grooved style, diverging above into three stigmatic lobes, which hang lower than the anthers in the pendulous flowers and have their receptive surfaces inwards, in a position, that is, but little favourable to self-pollination.

After pollination, the capsule, as it enlarges, rises once more into the erect position occupied by the flower-bud, the species thus affording an excellent example of what have been termed by Hansgirg *gamotropic* and *carpotropic* curvatures of the flower-stalk.

The plant is particularly abundant in the valley of the Thames and its tributaries, as in Christ Church Meadows, Oxford, at Minety, on the border of North Wilts, in the neighbourhood of Aylesbury, and formerly between Kew and Mortlake; but in

many localities it has been partially or completely exterminated by being transferred to gardens. It generally flourishes in alluvial meadows liable to inundation ; but we once found a plant in a wood of wild hyacinths, thirty or forty feet above the water-level, where its seed had, perhaps, been carried by birds.

Few of the floral charms of spring are more delightful than the sight of scores or hundreds of these gay bells swaying in the breeze of a May morning ; and the species is very accommodating in garden cultivation, as it may be naturalised in grass, in a well-watered rock-garden, or in the peaty soil under Rhododendrons. The fifty species of the genus are all, in fact, natives of North Temperate regions and present no difficulty in cultivation, though some of them have small green or brownish blossoms which are, perhaps, more curious than beautiful.

Dodoens called our British species *Flos Meleagris*, the name *Meleagris* being then that of the guinea-fowl, the sisters of the Argonaut Meleager having, according to Greek legend, been turned into guinea-fowl. As Gerard put it :—

"One square is of a greenish yellow colour, the other purple, keeping the same order as well on the backside of the flower as on the inside, although they are blackish in one square, and of a violet colour in another : in so much that every leafe seemeth to be the feather of a Ginnie hen, whereof it tooke his name."

As alternative names Gerard uses "Turkey-hen flower" and "Chequered Daffodil," while Parkinson calls it "Chequered Lily." Turkey-hen flower has been corrupted into the rather happy "Turkey-eggs" and the meaningless "Turk's-head," which are still in use, and is probably also the origin of the Minety name "Toads'-heads." The discontinuous distribution of the species may partly explain the very local character of some of its names. At Dinton, near Aylesbury, for instance, it is called "Crowcup," and at no great distance "Froccup" (which is probably Frog Cup, and may apply equally to the situations in which the plant grows and to its spotted flowers) is the common name. "Snake's-head" or "Snake's-head Lily" are somewhat widely distributed names. The Cumberland garden name "Deith Bell" may, or may not, be old ; but the most interesting of all its appellations are "Lazarus Bell" and "Leopard's Lily" in use near Crediton. These, no doubt, were originally "lazar's bell" or "leper's lily," and refer to the small bells that lepers were bound to wear to give warning of their approach.

Lobel gave the plant the name of *Fritillaria*, which Linné adopted, from the Latin *fritillus*, a dice-box, apparently by a sort of metonymy for a chequer-board, and this name is, of course, used in a similar sense for a well-known group of butterflies with wings of chequered black and brown.

While the erect capsule favours the dispersal of the seed, the pendent flower serves to protect both pollen and honey. At the same time, the blossoms may be cross-pollinated by any hovering insect, though probably mainly by bees.

XIX.—THE WILD HYACINTH.

Scilla non-scripta Hoffmansegg and Link.

IT might be expected that there would be less likelihood or doubt as to the proper names of the most familiar flowers ; but it is not so. Few English wild flowers are better known or greater favourites than the Wild Hyacinth, and yet there is but little agreement as to either its scientific, or its popular, or, as they are technically termed, its trivial, names.

The beautiful youth Hyacinthus was, according to legend, killed by the quoit of Apollo jealously blown aslant by Zephyrus, and from his blood sprang a lily with its petals darkly spotted with the letters A I, A I, alas !, or with a Y, the initial of Hyacinthus. According to another story it was from the blood of Ajax that this flower originated. By the earlier botanists our woodland plant was placed under Hyacinthus. Thus William Turner, in his "Names of Herbes" (1548), writes :—

"The commune Hyacinthus is muche in Englande about Syon and Shene, and it is called in Englishe crowtoes, and in the North partes Crawtees. Some vse the rootes for glue."

Gerard had in his garden in Holborn in 1596 "Hyacinthus anglicus cæruleus," as well as white and reddish varieties ; and in his "Herbal" he mentions it as "Hare-bell" and "Crow-leek."

Linnæus retained the plant in the genus *Hyacinthus* and, seeing that there is no such sad inscription on its petals as the story relates, added the specific name *non-scriptus*. Among the distinctive characters of the genus *Hyacinthus*, however, are the union of the perianth-leaves and the presence of three nectariferous glands on the ovary, characters which are absent in our plant and in other members of the large genus *Scilla*. Many botanists, however, have considered the Wild Hyacinth to have its perianth-leaves slightly united at the base ; and on this ground, or from the bell-like shape and reflexed points of the perianth, have erected it into a separate genus, which Link, in 1829, named *Agraphis*, the Greek equivalent of Linné's *non-scriptus*, adding the appropriate specific name *nutans*, drooping. Dumortier had, however, previously (in 1827) proposed the generic name *Endymion*, taken from that of another beautiful youth of Greek legend. Sir James Smith insisted that the perianth-leaves are as distinct from one another as in any polyphyllous perianth, and accordingly adopted the name *Scilla nutans*, writing of the plant also under the purely invented trivial name of "Hare-bell Squill." As he, however, admits, Smith had been anticipated by his rival and quondam friend Richard Antony Salisbury, who had in 1796 called the plant *Scilla festalis ;* but, since, according to our present international rules, the earliest Linnæan or post-Linnæan specific name must be retained and a name is followed by the authority for its two portions taken together, this plant is *Endymion non-scriptum* Gareke (1849) for those who think it entitled to rank as a distinct genus ; but *Scilla non-scripta* of Hoffmansegg and Link's "Flore Portugaise" (1840) for those who do not.

It is characteristic of the large genus *Scilla* (the name of which comes down from Dioscorides, and which comprises some eighty species, all natives of the Temperate regions of the Old World) to have a roundish bulb, linear, radical leaves, and slender filaments about half as long as the perianth-leaves and attached to them at the base. This particular species is distinguished by its drooping raceme of blossoms, the two bracts below each flower, the bell-shaped perianth with its reflexed tips, and the union between stamen and perianth-leaf extending half-way up the latter. It is distinctively a plant of Western Central Europe, not occurring wild in Switzerland, Italy, Eastern Germany, or Scandinavia.

While few things are more beautiful than our May woodlands carpeted with what has been well called the "heavenly blue" of the Wild Hyacinth, there are many cultivated forms that are better adapted to the flower-bed or the vase. Unless it can be naturalised in a wild garden by the thousand, it is, perhaps, a mistake to attempt to dig it up. If the attempt is made, it will be realised to how great a depth its bulbs manage to bury themselves, especially in sandy soil. As a recent writer expresses it :—

"The bulb is a small, pallid thing, living in the bowels of the earth, with a tail like a comet. I believe it was Persephone's flower, and started to follow her, for it seems to have got half-way to Hades."

It is this fact that explains how it is able apparently to monopolise ground occupied at other seasons by very different species. Under our oak-woods, for example, we commonly see a succession of Blue-bells, Bracken, and Soft-grass (*Holcus mollis* L.), the fact being that the bulbs of the Blue-bells are below the deep-seated rhizomes of the Bracken, while the grass is a surface-rooting species. This is what is termed *vertical zonation* or a *seasonally complementary association.*

The white gummy bulbs, nearly an inch in their longer diameter, have an acrid taste. The numerous leaves, from a foot to eighteen inches in length, rise erect at first, but, as they elongate, bend over in a graceful curve, their brilliant glossy green and the similarly coloured flower-stalks forming a beautiful contrast to the blossoms. In Mr. G. D. Leslie's charming "Letters to Marco" is an admirable description of how the minute shot-like seeds discharged from the wan carpels in autumn roll down the channelled midribs of these outward bending leaves and so find a lodgment at a little distance from the parent bulb.

Few of the popular names of the plant are in any way worthy of it. "Cuckoo-flower" is common to too many species ; neither "Crow-toes," "Cuckoo's-stockings," nor its northern equivalent, "Gowk's-hose," is elegant ; "Bell Bottle" is fairly descriptive of the shape of the flower ; and the West Country "Gramfer-greygles" apparently refers inadequately to the greyish-blue hue of the fully-open blossoms. "Wood Bells" is a pretty name recorded from North Buckinghamshire ; but by far the best is the Lancashire "Ring o' Bells." Nothing can be more apt than the implied comparison to the symphonia or curved staff hung with a number of bells.

XX.—BUTCHER'S BROOM.

Ruscus aculeatus Linné.

THE various Tribes into which the great Family *Liliaceæ* is divided are largely distinguished by the characters of their underground structures and their fruits. The former may be a corm, bulb, or rhizome; the latter capsular or berry-like.

While the examples of which we have hitherto been speaking have mostly short and thickened underground stems and capsular fruits, we have now to deal with a berry-bearing series with rhizomes.

The Butcher's Broom is a curious little plant, belonging to Western Asia, North Africa, and Central Europe, and probably in the south of England a relic of our earliest and most natural forest. It has a stout creeping rhizome from which it sends up many much-branched, rigid stems to a height seldom much exceeding two feet. These stems are round but furrowed, dark green, and glabrous, and are of considerable interest to the student of microscopic anatomy. They are the only woody stems among British Monocotyledons, being in many respects in cross-section like a miniature Palm. Below their epidermis and cortical tissue, the outer layers of which contain the green colouring-matter, is a band of dense woody tissue known as the *pericycle*, and within this the bundles or strands of vascular tissue are scattered through the pith-like ground-tissue, as in all Monocotyledons.

The ultimate branches or twigs are represented by flattened, leathery, leaf-like structures or *phylloclades*, ovate, ending in a sharp point and so twisted at the base as to be inverted. As these last for two years, the plant is termed an evergreen; but the true leaves are minute deciduous scales, in the axils of which the phylloclades originate. A slight difference in the width of the phylloclades which has been taken as a varietal character is in reality sexual, the narrower form bearing staminate flowers.

Flowers are not produced until the second year, between February and May, and at the close of that season the shoots commonly die down to the ground. Near the middle of what is in fact the under surface of the inverted phylloclade, a flower, about one-eighth of an inch in diameter, is produced in the axil of a minute bract. Its perianth consists of two whorls each of three pale green leaves, the three outer ones broader than the inner ones. The bushes nearly always bear flowers exclusively staminate or carpellate, that is to say, they are diœcious; but this is not entirely the case: they are, in fact, sub-diœcious, an occasional staminate flower occurring on a carpellate plant, and *vice versa*. The six stamens are united, their filaments forming a purple tube round the rudimentary ovary, while their yellow anthers form a curious zigzag margin to it. One anther is united to a second by their upper extremities, the second to the third by their lower ends, the third to the fourth by the upper, the fourth to the fifth by the lower, the fifth to the sixth by the upper, and the sixth to the first by the lower. In the carpellate flowers the purple

staminal tube is present as an investment to the ovary, but it bears no anthers ; and a discoid stigma surmounts a very short style.

The ovary is three-chambered and each chamber contains two ovules ; but when this ovary has ripened into a scarlet juicy berry about a third of an inch in diameter, two of the chambers have generally been suppressed and only one or two of the six ovules becomes a seed. The seeds are hard, white, and semi-transparent, globular, if solitary, hemispherical if there are two ; and the sweet taste of the juice of the showy fruit suggests that birds serve as the dispersive agent. If the plant as a whole does not suggest a Lily, these red berries recall those of its allies the Asparagus and the Lily-of-the-valley.

The resemblance of this dwarf plant with the spinous points to its phylloclades and its scarlet berries to the Holly naturally attracted notice at an early date, and we find the name Knee-holly in vocabularies of the eleventh century. The superficial likeness between its phylloclades and the leaves of Myrtle gave it the early names of *Myrtacantha*, *Myrtus acuta*, and *Myrtus sylvestris*, the Spinous or Wild Myrtle, and in some parts of Kent it is said to be known as Jew's Myrtle and to be supposed to have formed the material of the Crown of Thorns.

The young shoots were formerly boiled and eaten like Asparagus ; but being bitter were considered medicinal and became known to apothecaries as *Bruscum*, and in modern Italian we have the name under the two forms *Rusco* and *Brusco*. Turner in his "Names of Herbes" says :—

"Ruscus is called of the Poticaries Bruscum, in english buchers brome or Petigrue. Petigrue groweth in Kent wilde by hedge sydes."

The name *Petigrue* means Little Holly, from the French *petit* and *greou*, an old name for Holly.

Parkinson, in his "Theatrum Botanicum" (1640) adds :—

"The pliant twigges or stalkes with leaves served in former times for many uses, to binde their vines or other things, as *Virgil* his Verses doe testifie in the second of his *Georgicks* in these words,

*—Nec non etiam aspera Rusci, Vimina per sylvam, et ripis fluvialis arundo Cedatur ;**

and to preserve hanged meate from Mise eating, from whence came the *Italian* name of *Pongitopi*,† and for to make Broomes to sweepe the house, from whence came the name of *Scopa regia*, but the King's chamber is by revolution of time turned to the Butchers stall, for that a bundle of the stalkes tied together, serveth them to clense their stalles, and from thence have we our English name of Butchers Broome."

I have myself seen the plant put to this use not many years ago, and in Brittany, where it is more abundant than in England, it is used for garlands on festive occasions. The plant is so frequent in South London gardens that I suspect it to have once been common thereabouts in a wild state. It is abundant in Epping Forest and very luxuriant in the New Forest.

* "Moreover rough twines of Butcher's-broom must be cut in the woodland and the river-reed by the banks."

† "As if you would say Pricke-mouse, even as the *Germans* doe *Muessdorn*." (Modern German *Mausdorn* ; Flemish *Muisdoorn*.)

XXI.—THE LILY-OF-THE-VALLEY.

Convallaria majalis Linné.

IN medieval times the names *Lilium convallium* and *Lilium inter spinas*, the Lily-of-the-valley and the Lily-among-thorns, were familiar Biblical phrases ; but the association of these names with this beautiful British woodland species is more modern. So far as the Biblical names are not of purely general application they belong to some showy red-flowered species of the open, probably *Anemone coronaria* L., whilst the "Rose of Sharon," with which it is often coupled, may be *Narcissus Tazetta* L.

To Fuchs (1542) our plant is *Ephemerum non lethale ;* but Turner, in 1548, writes under that heading :—

"Ephemerum is called in duch mayblume, in french Muguet. It groweth plentuously in Germany, but not in England that euer I could see, sauynge in my Lordes gardine at Syon. The Poticaries in Germany do name it Lilium conuallium, it may be called in englishe May Lilies."

The German and French names remain unchanged to-day, though the latter sometimes has the month of flowering added, becoming *Muguet de mai.* Dr. Prior says that *Mugget* also occurs as an English name ; but Gerard says of the French,

"there is likewise another herbe which they call Muguet, commonly named in English Woodroof" ;

a thirteenth-century Vocabulary has "muge de bois, wuderove" ; and Lyte (1578) applies Muguet to the fragrant yellow-flowered species of the allied genus *Galium*, the Bedstraws, *G. Cruciata* Withering, and *G. verum* L. "Muguet" is the Old French *musquet*, from the Latin *muscatus*, musk-scented ; but there is little likeness between the perfume of these *Rubiaceæ*, which is that of coumarin or "new-mown hay," and the rich luscious scent of the Lily-of-the-valley, which approximates to that of various other white blossoms, such as Jasmine, Butterfly Orchis, Mock Orange, and Stephanotis.

Though Linnæus adopted the generic name *Convallaria*, from the Latin *convallis*, a valley, adding the specific name *majalis*, "belonging to May," the species is by no means specially characteristic of valleys, flourishing in woodland at an altitude of a thousand feet, even in the north of England. That the word "valley" conveys but little meaning to many English rustics may be gauged from the fact that on the borders of Buckinghamshire and Bedfordshire, where the plant is abundant in the fir-woods on a sandy soil, it is commonly offered for sale as "Lilies and valleys," and the leaves are termed "valleys" ; whilst the senseless-seeming phonetic corruption of names is well exemplified in "Liricon-fancy," which is recorded as early as Lyte's "Herball" (1578).

The plant has slender succulent rhizomes, with long internodes, which often become thickly entangled underground, and in many places the plant spreads for years over a considerable area though seldom flowering. Lateral branches rise to the surface, bearing several purplish leaf-sheaths and two or three fully-developed

foliage-leaves. These are sheathing at the base, with a long slender petiole widening into the ovate-lanceolate or elliptical acute blade, which is three or four inches long, in addition to an even greater length of stalk. The leaves take an erect or ascending direction, and there is but little difference between their two smooth surfaces. Though translucent when young, showing the varying, but always graceful, curvature of the many longitudinal veins, which, diverging at their base, converge once more at their apex, the leaves soon become dull and opaque.

The flower-stalk rises from the axil of the uppermost leaf-sheath, alongside of, but not between, the sheathing bases of the leaves. It is angular or semi-cylindrical in section, and rises, with a graceful droop, some six to ten inches in height, bearing from six to twelve pendulous blossoms. These are on slender curved pedicels, each arising in the axil of a lanceolate, membranous, deciduous bract. The perianth forms an almost hemispherical bell, about one-third of an inch in diameter, with six minute recurved lobes. The six stamens are attached to its base and their arrow-like anthers are enclosed within the bell, while the style and three-angled stigma project slightly below it. Anthers and stigma either mature simultaneously or the former somewhat in advance. In spite of their attractive perfume, the flowers excrete no nectar ; but their position and form suggest pollination by hovering insects, which may not only come for pollen but may pierce the delicate perianth and suck some of its sweet and fragrant juice. If not visited by insects, however, the flowers seem generally capable of self-pollination ; and they are succeeded by globose, scarlet, berry-like fruits which may reach half an inch in diameter.

Owing to the transfer of the Solomon's-seals to the genus *Polygonatum*, the Lily-of-the-valley is now the only species in the genus *Convallaria ;* but it has several varieties in cultivation, such as some with doubled perianth, and one with reddish flowers which was grown, as far back as 1596, by John Gerard in his garden in Holborn. None of these, however, are so well worth growing as are some of the larger-flowered pure white forms.

Lilies-of-the-valley are extremely popular as cut flowers, so that they are grown in every garden and, either by being forced or retarded, can now be obtained almost all the year round. They are not difficult to grow, but prefer a rich sandy well-drained loam, to which manure and especially leaf-mould have been added, and a shaded position, such as under the lee of a north or west wall. They should be planted, or lifted, separated and replanted singly, in September, and not be again disturbed for three or four years ; but the bed should be manured every winter. In picking leaves it is important not to gather more than one from each crown, as otherwise the storing up of food in the rhizome is prevented.

Plants are forced in the dark at 80-100° Fahrenheit ; and retardation is effected by keeping the crowns in sand, in refrigerators kept a few degrees below the freezing-point, until a few weeks before they are wanted to flower.

XXII.—THE HERB PARIS.

Paris quadrifolia Linné.

IN woods, especially those of Ash and Beech, on warm well-drained soils, generally distinctly calcareous, we may find the Herb Paris, a local or somewhat uncommon plant with several characters of considerable structural interest. It is, no doubt, often overlooked when growing in the midst of Dog's Mercury; but in some woods on the Cotteswolds I have seen it practically replacing that usually much more abundant species.

It has a long, slender, white rhizome, much like that of the Lily-of-the-valley, which grows a little below the surface of the soil in a monopodial manner, *i.e.* continuously in a straight line, the aerial stems being produced laterally. These erect aerial stems, springing from the axils of leaf-scales, may reach a foot or even more in height, though the plant often occurs in a stunted condition, only reaching a few inches. Specimens are recorded from Harefield, Middlesex, of a yard or more in height. The stem is round, tapering, and of a dull dark green, and the whole plant is destitute of that gloss which is so general among Monocotyledons and especially among *Liliaceæ*. At the summit of the aerial stem, which, it will have been perceived, is really a branch, is a whorl of leaves. As these are the only foliage-leaves borne by the plant we term them leaves, though it is not easy to discriminate morphologically between them and the whorl of three leafy organs similarly placed below the flower in the genus *Anemone*, which is termed an involucre. As the specific name *quadrifolia* indicates, our species has generally four leaves in a whorl. An exotic species, *P. polyphylla*, has ten or twelve leaves in a whorl; and where our species is abundant, perhaps as many as one per cent. of the plant will vary by bearing three or five, six, seven, or eight leaves. In the five-leaved examples we have sometimes found the extra leaf below the rest, though it is generally in a whorl, *i.e.* at the same level with them. It is, however, to the typical whorl of four that the plant owes most of the names by which it is known. Gerard, for instance, speaks of it as having

"fower leaves directly set one against another, in maner of a Burgunnion crosse or a true love knot; for which cause among the auncients it hath beene called herbe Truelove";

and Dr. Prior pointed out that this is also the true etymology of the name *Herba Paris*, which we owe to Matthiolus (1583), and which we have translated as Herb Paris. This is not, as has often been said, derived from the Latin adjective *par*, equal, because there are an equal number of leaves in each of the floral whorls, but from the substantive *par*, a pair, in the possessive. The name, therefore, means the Lover's plant, and the word *paris* should have been written with a small p.

The leaves spread horizontally and are three to five inches long, broadly ovate or elliptical, acute, glabrous, shortly stalked, with from three to five principal longitudinal veins which branch and anastomose or unite their branches in a manner

very unlike that usual among Monocotyledons. Their non-lustrous surface and somewhat yellowish shade of green serve also to mask the true affinities of the plant.

In the centre of the whorl of leaves rises the peduncle, slender, angular, erect, and from one to three inches long, terminating in the solitary flower. It is here that the remarkable symmetry of the plant is seen. Normally there are four sepals in a whorl so situated that they alternate with the four foliage-leaves, four petals alternating with the sepals, two whorls each of four stamens and four united carpels. If, however, there are five foliage-leaves all the floral whorls will also be in fives; and it will be noticed that, like the venation and texture of the foliage-leaves, these numbers of floral organs are more Dicotyledonous than Monocotyledonous. Nor is it only in number that this symmetry shows itself: there is also a considerable resemblance in form between the parts of the four outer floral whorls. The sepals are nearly an inch long, very narrowly lanceolate, and tapering into a long point, green and persistent in the fruit stage. The petals are of the same length, so that when fully open the flower is nearly two inches in diameter; but being narrower they are described as subulate rather than lanceolate, and they are yellow and also persist in the fruit stage. The stamens are of a remarkably similar form and colour, their filaments widening at a short distance from their bases, the anthers long, linear, and dorsifixed, and the connective prolonged from between the two anther-lobes into a long, tapering appendage, making the entire stamens about as long as the sepals and petals.

The rounded superior ovary has four external lobes corresponding to its four chambers; and four separate styles, shorter than the stamens, spread outwards from its summit, with downy stigmatic surfaces along the upper side of their extremities.

The flowers produce no honey but have a strong putrescent smell, which, together, perhaps, with the colour of the ripening berry, which turns from reddish to an almost black purple, serves to attract flies. The flower is markedly protogynous, so that it is probably seldom self-pollinated.

The solitary conspicuous blackish fruit, to which the plant owes its German name of *Einbeere* and an English equivalent, probably suggested to the early botanists that the plant had some affinity with the Deadly Nightshade and was, therefore, also likely to be dangerously narcotic. Caspar Bauhin (1671) calls it *Solanum quadrifolium baccatum*. Though this property has not been verified, the rhizome possesses a purgative character of, it is stated, about half the strength of Ipecacuanha.

We are not surprised at these earlier workers being puzzled as to the relationship of this plant, especially before the similar but more attractive American genus *Trillium* had become familiar.

Turner, following Fuchs, as he often does, classes it in his "Names" (1548) under *Aconitum*, mentioning its occurrence at his native Morpeth. He writes that it

"is called Pardalianches, whiche we may call in englishe Libardbayne or one bery. It is much in Northumberland in a wodde besyde Morpeth called Cottingwod. It hath foure leaues lyke vnto great plantaine, & in the ouermost top a litle blacke bery lyke a blacke morbery, but blacker & greater."

XXIII.—ANALYTICAL DRAWINGS OF LILIACEÆ.

THE great variety of type within the limits of a single Family is well represented by the eight members of the Family *Liliaceæ* that are figured on this Plate.

The Order *Liliifloræ* comprises plants, either herbaceous or arborescent, which have generally a flower of fifteen parts in five whorls of three, though one whorl of stamens is sometimes absent. The perianth may be *homochlamydeous*, *i.e.* with both whorls alike, or *heterochlamydeous:* the ovules are usually *anatropous* or inverted; and the seed usually has fleshy or cartilaginous albumen. It includes the *Juncaceæ* and *Liliaceæ*, with a superior ovary; and the *Amaryllidaceæ*, *Dioscoreaceæ*, and *Iridaceæ*, in which it is inferior.

The Family *Liliaceæ* is one of the largest, and is universally distributed, although a great many of its members are typically xerophytic bulbous or rhizomatous plants and whole Tribes are restricted to special regions.

The inflorescences, not represented in these analyses, are generally racemose if only branched once, but cymose in any secondary branching. The former is exemplified by *Narthecium*, *Scilla*, and *Convallaria;* the latter by *Allium*.

The flower is usually perfect, polysymmetric, pentacyclic, trimerous, and hypogynous, with two petaloid perianth-whorls, six stamens, and an indefinite number of ovules in two rows in each of the three chambers of the ovary, attached to a central placenta. It generally secretes nectar and is pollinated by insects. *Ruscus* is exceptional in being diœcious, with inconspicuous green perianth and only one or two seeds; and *Paris* in being generally tetramerous, thus having twenty floral leaves instead of the usual fifteen.

Dr. Engler subdivides the Family into eleven Tribes, of which only four are represented among British plants. Of the two hundred genera we have but twenty, and many of these are represented by single species. There are little more than thirty truly British species.

In the Tribe *Melanthioideæ*, represented here by *Narthecium* and *Colchicum*, the characters are very varied, the underground stem being either a bulb, a corm, or a rhizome; the anthers bursting inwards (*introrse*) or outwards (*extrorse*); and the capsule either through the midribs of the carpellary leaves (*loculicidally*), or between their edges (*septicidally*). The inflorescence is, however, uniformly terminal; and the fruit is never a berry.

The first row of figures on our Plate is the analysis of *Narthecium*, the Bog Asphodel. The first figure is one of the star-like blossoms; the second, one of the "villous" or hairy filaments, after its anther has withered. The third is a young fruit around which the perianth-leaves (now ascending) and the filaments persist; the fourth shows the same enlarged; the fifth, the remarkable elongated seed; the sixth, the same enlarged; and the seventh, a section.

The second row of figures represents *Colchicum*, the so-called Meadow Saffron or Autumn Crocus. The first figure is a reduced picture of a flower in section. The ovary, although at the bottom of the long perianth-tube and entirely underground, is superior. Whilst the flower appears in autumn, the fruit is carried up above ground, by the elongation of the stem below it, together with the leaves, in the following spring, as seen, also reduced in size, in the second figure. The third and fourth represent one of the extrorse stamens, the latter being a side view. The fifth figure is an unripe fruit ; and the sixth is a transverse section showing its three chambers.

The Tribe *Allioideæ*, chiefly represented by the genus *Allium*, analysed in the third row of figures, is mainly characterised by its cymosely umbellate inflorescence enclosed in a double spathe. Here the first figure is a flower ; the second, a perianth-leaf with its superposed stamen ; the third, the gynæceum, or ovary, style, and stigma ; and the fourth, a cross section of the same.

The Tribe *Lilioideæ*, represented by *Fritillaria* and *Scilla*, has bulbs with terminal racemose inflorescences and introrse anthers. In the fourth row, the first figure is one of the chequered perianth-leaves of Fritillaria ; the second figure represents its essential organs ; the third, the ovary ; the fourth, a longitudinal section of it ; and the fifth, a transverse one. The sixth shows the loculicidal dehiscence of the ripe capsule ; and the seventh, the winged seed.

In the fifth row, the first figure is a flower of *Scilla non-scripta ;* the second, the same as seen from above ; the third, two perianth-leaves and stamens, showing the two different lengths of the latter ; the fourth, the gynæceum ; the fifth, the same enlarged ; the sixth, an enlargement of the stigma, showing the pollen *in situ ;* the seventh and ninth, transverse sections of the ovary at two stages ; the eighth, a longitudinal one ; and the tenth, a ripe capsule.

The Tribe *Asparagoideæ*, represented here by *Ruscus*, *Convallaria*, and *Paris*, has a rhizome and a baccate fruit.

The sixth row of figures deals only with the female flower of *Ruscus*. The first figure is a *cladode* or leaf-like branch bearing a flower ; the second shows the same later ; the third, a young fruit ; the fourth, the ovary enclosed in the tube of united filaments ; the fifth, a longitudinal, and the sixth, a transverse, section ; the seventh and eighth, a ripe fruit, the latter from below ; and the ninth, the same in section.

The Lily-of-the-valley is represented by the penultimate row of figures, showing a flower, a longitudinal section through it, a stamen, the gynæceum, and a transverse section.

Lastly, Herb Paris is represented by a flower, one of its remarkable stamens with its long tapering connective, the gynæceum, the ripe fruit, and longitudinal and transverse sections through it.

XXIV.—THE SNOWDROP.

Galanthus nivalis Linné.

IN spite of their many obvious resemblances in habit of growth, texture, and the number of their floral leaves, the Family *Amaryllidaceæ* was, until recently, separated by most botanists from the *Liliaceæ*. Although possessing a bulb, fleshy, glabrous, linear leaves, a spathe, and a flower of fifteen floral leaves in five whorls of three each, the Snowdrop and its near allies were set apart from the types that we have just been describing by having an inferior ovary. This character is conspicuous at a glance, the ovary being seen at once below the flower; but it is not now considered sufficient to separate two distinct Families of plants, identical in almost every other characteristic.

The Family comprises some 700 species, in 75 genera, mostly natives of the drier subtropical regions, and having corresponding xerophytic characters, such as bulbs and erect succulent or rigid leaves often with a glaucous surface.

The Family takes its name from the beautiful Belladonna Lily (*Amaryllis belladonna* L.) of South Africa; but, besides the three genera represented among British plants, the best-known genus is, perhaps, *Agave*, the so-called "Century plants" of tropical America, different species of which yield valuable fibres, such as Pita grass, Silk grass, and Ixtle or Sisal hemp, and pulqué, the favourite fermented drink of the Mexicans.

The genus *Galanthus*, which is confined apparently to Europe and south-west Asia, and only includes about ten known species, was named from its opaquely milk-white blossoms (from the Greek γάλα, *gala*, milk; ἄνθος, *anthos*, a flower), and is characterised by its bulb, its radical linear leaves, and its solitary drooping flowers with their inner perianth-leaves shorter than the outer ones and notched at their apices.

Our species, *G. nivalis* L., of which the specific name signifies "belonging to snow," is, at the best, but a doubtful native of Britain. It has long been a favourite in gardens and apparently soon degenerates to the wild form when the soil is no longer cultivated; whilst it is often excessively difficult to say with certainty that a particular spot may not have been the site of cultivation at some past period. In such localities as the Arniston Woods, Edinburgh, where it covers acres of ground, the banks of the Tees about Blackwell and Conniscliffe, and some copses in Gloucestershire and Hereford, it certainly has the appearance of being wild, though it is true that bulbous plants may remain in the ground and defy eradication during long terms of years. The glens at the northern foot of the Herefordshire Beacon, where Withering saw it growing a hundred and sixty years ago, are, it is true, less than a mile from Little Malvern Priory; and, as the flower finds no mention in our earlier poets, it has been suggested that it was a monastic introduction of medieval times. At the same time, there is nothing in the continental distribution of the species,

"from Holland southwards," to make its natural occurrence in this country improbable.

The egg-shaped bulb is about half an inch in diameter and is built up, like that of an onion, of successive "tunics," each of which forms an almost complete investment. From it rise only two leaves and the flower-stalk, the former fleshy, linear, strongly keeled, blunt of apex, and bluish with a mealy covering of waxy bloom. The leaves are enclosed at the base in a tubular membranous sheath; and, whilst we may often see them actually melting their way erect through the snows of January, they afterwards only assume a slightly more divergent or "ascending" direction.

The slender cylindrical peduncle rises above the leaves and bears a single transparent sheathing spathe, notched at its summit, and having two bright green nerves. From the axil of this spathe springs the slender arching pedicel which bears the solitary blossom, the "lone flower" of Wordsworth, erect in the bud but afterwards the "droop-headed snowdrop" of Shelley. The three pure white obovate concave sepals hang from the obconic ovary and slowly spread outwards until the lax blossom has a diameter of fully an inch. A recent writer has described how

"Slowly and languidly those white wings of theirs opened to show their little green-edged petticoats, as if the angel in them should reveal the woman underneath."

The three stiff little petals within are wedge-shaped with a notch at the top and a green crescentic blotch on the outside of it, whilst down the inner surface run two green grooves in which a little nectar is secreted. The six short and capillary filaments bear yellow anthers, much longer than themselves, converging into a cone round the style, against which they press the two terminal pores by which their pollen is to be discharged. Between the two anther-lobes a minute bristle-like point extends outwards. The single style carries its terminal stigma beyond the cone of anthers; and there is no doubt that the flowers are often cross-pollinated by hive-bees, almost the only large insects that are about at the early season when the Snowdrop is in bloom. The hovering insect, probing for the scanty nectar, will touch the bristle-like appendages of the anthers and thus detach the terminal pore from the style, so that a shower of pollen will fall upon its head. The flowers are, however, *homogamous*, *i.e.* anthers and stigmas mature simultaneously, and they remain open a long time. If, therefore, crossing by insect agency should fail, the anthers may separate spontaneously and self-pollination occur.

The name "Snowdrop" is probably derived from the German *Schneetropfen*, and refers to the pendants which formed so characteristic a feature in sixteenth-century jewellery; while the pretty English names "Purification-flower," "Candlemas Bells," and "Fair Maids of February" all refer to that season of the plant's flowering when white-robed maidens carried candles at the Feast of the Purification.

XXV.—THE SUMMER SNOWFLAKE.

Leucojum æstivum Linné.

IT is a beautiful sight, on a bright morning in May, to see the winding banks of the little river Loddon with masses of the white bells of the Summer Snowflake, or Loddon Lily, standing erect, or hanging over, and reflected in, the water. The clumps of luxuriant foliage have, perhaps, a less English look than the fine clusters of blossom ; and in many respects the claims of this lovely species to be considered indigenous appear even less well-founded than those of its ally the Snowdrop. First recorded from both banks of the Thames below London, where it is now extinct, it seems to have a fairly continuous distribution from Suffolk to Oxford, Dorset, and Kent, *i.e.* for the south-eastern counties ; and this agrees with its continental extension, from Denmark and Holland southward. It is, perhaps, suspicious that it is frequently recorded from withy eyots, where various exotic species of osier are often cultivated, with which it may possibly have been introduced ; and its occurrence along the banks of the Loddon and not on other Thames tributaries reminds the sceptical botanist of the migration down stream of the White Water-lily from private water into the Cherwell and thence into the Lower Thames. The rapid spread of such other river-bank species as the American Balsam (*Impatiens biflora* Walt.) on Tillingbourne, Wey, and Thames, and *Mimulus Langsdorffii* Donn on many of our streams, suggests possibilities for its foreign origin and ready dispersal ; but, whether indigenous or not, there can be no gainsaying its beauty.

It has many of the structural characters of the Snowdrop, the two genera *Galanthus* and *Leucojum* having very much in common. In their likenesses and unlikenesses they are, in fact, a good example of generic distinctions. Like *Galanthus*, *Leucojum* has a tunicate bulb ; strap-shaped, radical leaves ; pendulous and generally white flowers borne on a peduncle rising direct from the bulb ; fifteen floral leaves in five whorls of three each ; the six stamens in two whorls but of equal length ; and the three-chambered ovary inferior. On the other hand, *Leucojum* differs from *Galanthus* in having numerous leaves to each bulb ; generally several flowers on each scape ; flowers which do not expand to the same extent as do those of the Snowdrop, but retain an incurved bell-like form ; six perianth-leaves almost alike, each with a green patch at the tip externally and internally ; anthers with no bristle-like tip, and opening by an external longitudinal slit as well as by the terminal pore on the inner surface ; and a club-shaped style.

The name *Leucojum*, now definitely applied to this genus, since botanists have agreed in such matters to follow as far as possible the nomenclature of Linnæus, dates, it is true, as far back as Dioscorides, in the first century ; but it has been used for a great variety of plants. Etymologically it signifies a white violet, from the Greek λευκὸς, *leukos*, white, and ἴον, *ion*, a violet ; but its last three letters may, perhaps, be looked upon as a mere termination, and then, though one species has

rosy-red blossoms, the name will be recognised as on the whole appropriate. The English name "Snowflake" is quite modern, having been coined apparently by William Curtis (1746-99), the founder of the "Botanical Magazine" and the "Flora Londinensis"; but it is so obviously suitable as to have become general wherever the plant is grown or known. The specific name of the commoner of the two species that occur in England seems to us less well chosen; since although the other species, *Leucojum vernum* L., flowering from March to April, is justly called the Spring Snowflake, this species, *L. æstivum* L. (from the Latin *æstas*, summer), is generally in flower in May and over by June, so that it belongs to a season that is hardly to be called summer.

The flowers of the year were long ago grouped in six floras: the Primaveral, following on the close of January frosts; the Vernal, coming on about the beginning of May; the Solstitial, towards the middle of June; the Æstival, in July; the Autumnal, in September; and the Hibernal, in November. According to this division *L. vernum* L. is Primaveral; *L. æstivum* L., Vernal.

The earlier-flowering species, *L. vernum* L., has a more doubtful claim to rank as a British plant, occurring only in some Dorsetshire copses. It is a much smaller plant than *L. æstivum* L., and bears but one or at most two blossoms on each scape.

In the "summer" species the bulb is roundish and an inch long, and the numerous leaves are about eighteen inches long, linear, obtuse, and bluntly keeled, and are enclosed with the flower-stalk in one or more very short, membranous sheaths. The hollow, two-edged flower-stalk stands erect at first, attaining a height about equal to that of the leaves, and bearing the flowers, in a cluster of from two to six together, on slender pedicels, in the axil of the unnotched erect spathe. The buds are borne erect, adapted, it is said, to shoot off water from their closed apices; and they droop as they expand. In the fruiting stage the whole scape falls prostrate among the leaves, which also spread out more horizontally. The flowers have neither perfume nor excreted honey; but sugar occurs in the delicate tissue of the six similar perianth-leaves just below the green spots which occur both inside and outside the apex of the perianth-leaf, and some of this may sometimes be extracted by boring insects. As the pistil is rather longer than the six stamens, though all are enclosed within the bell-shaped perianth, self-pollination is probably exceptional. The six ovate perianth-leaves, each about three-quarters of an inch long, are slightly united at their bases. The six short, flattened filaments rise, or rather hang, from the top of the top-shaped inferior ovary; and the numerous seeds are simple, rounded, and black.

Snowflakes are easily cultivated, preferring a rich sandy loam with leaf-mould, but not with farmyard manure in contact with the bulbs. Cloves will form readily and increase the number of bulbs with very little attention.

XXVI.—THE DAFFODIL.

Narcissus Pseudo-narcissus Linné.

IT is impossible to keep to plain prose when writing of the Daffodil. Poetical associations cling to its every mention.

The genus *Narcissus* is not a large one, some forty species at most, and belongs mainly to the sunny regions of the Mediterranean. There one species is almost certainly the Rose of Sharon of Holy Writ, and of it Mohammed said :—"He that has two cakes of bread, let him sell one of them for some flower of the Narcissus, for bread is the food of the body, but Narcissus is the food of the soul."

Another, the lovely Pheasant's-eye Narcissus (*N. poeticus* L.), was the plant to which the earliest botanists Theophrastus and Dioscorides applied the name *Narcissus*, whilst it owes its specific name to its celebration by the Classical poets. Though mythology might say that it arose from the metamorphosis of the beauteous youth who became enamoured of his own reflection, one of the old poets objects that Persephone was gathering Narcissi in the plains of Enna in Sicily—or was it in Nysia in Asia ?—long before that youth was born. Pliny is accepted by modern authorities when he says that the name comes from *νάρκη*, *narke*, torpor, and refers to the narcotic effect of the plant, so that the story of the vain youth was, perhaps, only invented to explain a name the origin of which had been forgotten.

As not being the plant referred to by Theophrastus, Dioscorides, and the ancient poets, our more northern species was termed by Dodoens *Pseudo-narcissus*, the False Narcissus ; but it is as Daffodils, the "Daffodils

That come before the swallow dares, and take
The winds of March with beauty,"

that, with Shakespeare, Herrick, Wordsworth, Keats, and other poets innumerable, we love this exquisite plant.

Its ovoid blackish tunicate bulb readily multiplies individuals, which may thus extend their area over meadow or woodland. Many species have naturally—being easily cultivated—been grown in our gardens for ages, so that even Gerard, in the reign of Elizabeth, is able to speak of twenty-four different kinds as then commonly grown in London gardens ; and, especially if some supposed medical virtues could be ascribed to them, they would certainly not have been absent from the monastic gardens of medieval times. There are, indeed, some local names which suggest the connection of this flower in the popular mind with neighbouring religious houses ; and undoubtedly many localities, especially for the double variety, may be attributed to monastic introduction.

The keenest criticism of the claims of plants to appear in lists of native species has not, however, excluded the opinion that this one is truly indigenous; and when, whilst, in the words of Mr. Masefield's grim poem,

"The grass is dotted blue-grey with their leaves,
Their nodding beauty shakes along the ground,"

the feelings they arouse in our minds are mostly joyous. After the gloom of winter, March is Tennyson's

"roaring moon of daffodil and crocus";

and it would seem a somewhat morbid fancy that will say, with Herrick,

"When a daffadill I see
Hanging down his head t'wards me,
Guesse I may, what I must be:
First, I shall decline my head;
Secondly, I shall be dead;
Lastly, safely buryed."

To most of us, as to Keats

"A thing of beauty is a joy for ever,
Its loveliness increases, it will never
Pass into nothingness" . . . .
"and such are daffodils
With the green world they live in."

The manifold corruptions of such pretty popular names as "Lent Lily" into "Lantern Lily," and the apparent mingling of Daffodil and Saffron Lily into "Daffadowndilly," point, like the playfulness of the French "Jeannette jaune," to the far-back appreciation of the beauty of this wild favourite. There is but little in common between the merely intellectual pleasure of a "rare find" and the glee with which we are filled by the sight of such Spring beauty, however familiar it may be. It is a time for poetry rather than for science, and every line of Wordsworth's enthusiasm finds an echo in our own.

"I wander'd lonely as a cloud
That floats on high o'er vales and hills,
When all at once I saw a crowd,
A host of golden daffodils,
Beside the lake beneath the trees
Fluttering and dancing in the breeze.

"Continuous as the stars that shine
And twinkle on the milky-way,
They stretched in never-ending line
Along the margin of a bay;
Ten thousand saw I at a glance,
Tossing their heads in sprightly dance.

"The waves beside them danced, but they
Out-did the sparkling waves in glee:—
A poet could not but be gay
In such a jocund company!
I gazed—and gazed—but little thought
What wealth the show to me had brought;

"For oft, when on my couch I lie
In vacant or in pensive mood,
They flash upon that inward eye
Which is the bliss of solitude;
And then my heart with pleasure fills,
And dances with the daffodils."

Among the distinctive characters of the wild Daffodil we can merely note the slightly keeled, sub-glaucous, and blunt leaves; the large very shortly stalked solitary flower, drooping slightly, in the axil of a pointed membranous spathe, at the summit of a peduncle less than a foot in height; and the pleasingly contrasted pale yellow pointed perianth-segments and deep golden funnel-shaped coronet equalling them in length, and with recurved margin slightly notched into six rectangular lobings. The latest view as to the morphological nature of this coronet, free as it appears of all union with the six included stamens, is that it represents twelve united stipular appendages to the stamens.

XXVII.—THE BLACK BRYONY.

Tamus communis Linné.

TWINING and climbing plants of all kinds are far more abundant in the dense vegetation of Equatorial regions than they are in our Temperate Zone. The small Family of the Yams, named, from the somewhat shadowy early herbalist, *Dioscoreaceæ*, is mainly southern, tropical, or extra-tropical, and but scantily represented in the north. The acrid starchy tubers of several species of *Dioscorea*, mostly natives of the Old World Tropics, are well-known articles of food and have been introduced into the West Indies. By cultivation, or at least on being cooked, these Yams lose their original acridity. One species, *D. pyrenaica* Bubani, occurs in the Pyrenees, an interesting relic apparently of the northward Post-Glacial migration ; but otherwise the Family is only represented in Europe by the two species of the genus *Tamus*. Another remarkable species, *Testudinaria Elephantipes* Salisbury, the Hottentot Bread, which can be seen in most Botanical Gardens, is a native of South Africa, and produces an enormous tuber rising above the ground and covered by a thick tessellated cork, from which, during the rainy season, arises a slender climbing stem. These tuberous structures by which these plants hibernate or æstivate—pass through, that is, the season unfavourable to vegetation, whether that season be a cold winter or a dry summer—are of varied morphological nature. In *Testudinaria* it is the first internode of the stem that is thus enlarged : in *Tamus* it is a lateral outgrowth of the first two internodes, which forms a large, fleshy, ovoid, but entirely subterranean mass. This is externally black and thus, no doubt, gained for this genus the name of Black Bryony, as distinguished from the white tubers of *Bryonia dioica* Jacquin, a plant in no way related to *Tamus*, although the two often grow side by side.

From this tuber, in our hedgerows, in spring, the rapidly-growing slender twining stem may be seen to develop, growing to a length of several yards in the single season of its existence and sometimes branching, but from the first dependent upon some support round which it can twine. It is angular in section, but has none of the roughness of the Hop or the dense woolliness of the White Bryony.

It is to this rapidity of growth that the name Bryony, the Greek *βρυωνία*, *bruonia*, from *βρύω*, *bruo*, to shoot, refers ; but the origin of Gesner's name *Tamus*, or rather of Pliny's name *Uva taminia* for the fruit—a name which lingers in the Italian *tamaro*—is unknown. Elongation taking place apparently intermittently on the many sides of the apical shoot, brings about the *circumnutation* or nodding movement described by Darwin, in which the slender apex swings round from its older portion once in two and a half to three hours. This takes place in a constant direction, which in the *Dioscoreaceæ* is, as traced from below upwards, the direction in which the hands of a clock travel, *i.e.* from right to left, or *sinistrorse*, a direction which is, perhaps, less common among twining stems than the *dextrorse*, or *counter-clockwise*, twist.

The genus *Tamus* comprises only two species, *T. cretica* L., a native of the Eastern Mediterranean region, and our British species, which shows the southern character of the Family by not advancing to the north of England and Belgium. *T. cretica* L. has trilobed leaves, whilst one great charm of our own species is the graceful but simple outline and lustrous gloss of its foliage. Its leaves, which arise singly at the nodes, have relatively long petioles, a heart-shaped base, and a long tapering apex recalling the "drip-tips" so frequent among the climbing plants of the jungles of the Tropics. Minute when first expanded, they enlarge to a length of three inches and sometimes become slightly angular or obscurely lobed. They have reflexed, awl-shaped stipules and from five to seven primary veins running palmately from the base of the leaf in sweeping curves following the leaf-margins, much as do those of the Lily-of-the-valley, but branching repeatedly and anastomosing in a manner more like those of *Paris* or of Dicotyledons. The shining lustre remains on the leaves from their first olive-green unfolding until autumn, when their deeper green turns to a dark bronzy purple wellnigh black, and then decays to a vivid lemon-yellow.

The plant is diœcious, both male and female blossoms, which appear in May and June, being minute, only about one-sixth of an inch across, green, bell-shaped, and polysymmetric. The male are borne on slender slightly-branched axillary racemes and have six deeply-divided perianth-segments, united below and spreading horizontally above, and six short stamens. The female are in shorter, few-flowered clusters, each blossom showing the smooth ovate ovary below its perianth. As summer advances to autumn this enlarges to an oval juicy berry, half an inch in length, crowned by the remains of the persistent perianth, and turning from a limpid emerald-green to an equally translucent crimson. Each berry consists of three carpels and in its earlier stage had three spreading stigmas. Each carpel produces one or two globose, blackish, albuminous seeds, and in the ripe berry the partitions between the chambers disappear.

The acrid clammy juice of the tubers has purgative and diuretic properties; and the use of the grated tubers for plasters to remove the discoloration of bruises has gained for the plant its French name of *Herbe aux femmes battues*. The young shoots lose their acridity on being boiled, and have been used instead of Asparagus; whilst the berries steeped in gin or brandy are a popular and excellent remedy for chilblains. It is, perhaps, well that these beautiful fruits should, according to the wholesale dictum of the Misses Jane and Ann Taylor that

"Fruits in lanes are seldom good,"

bear among children the name of Poison-berries. It was probably merely the serpentine twining of its festooned stems that—by the doctrine of signatures—earned the plant the names of Snake-berry and Adder's-meat and a repute as a cure for snake-bite; but in the old herbals many other medical virtues are ascribed to the species.

XXVIII.—THE YELLOW FLAG.

Iris Pseudacorus Linné.

THE considerable Family *Iridaceæ* includes few plants which are applied to useful purposes but many valuable in our gardens from the beauty of their flowers. It is chiefly extra-tropical, South Africa being its chief centre at the present day; but the genus *Iris* belongs rather to the North Temperate Zone. While varying considerably in floral form, the plants of this Family agree in being perennial and herbaceous, mostly with fleshy underground stems and relatively long and narrow leaves often equitant, two-ranked, that is, conduplicate, or folded down the midrib, and with both margins of one outside those of the next, as if astride of them. In all, the perianth is superior and petaloid, consisting of six floral leaves in two whorls; whilst there are but three stamens. These alternate in position with the perianth-leaves of the inner whorl, but not with the carpels. In other words, the three carpels are said to be superposed on the stamens, an anomaly which appears to be accurately explained by the suppression of an inner staminal whorl. The stamens are epigynous and their anthers burst outwards. The three-chambered, many-ovuled ovary is surmounted by a simple style, which expands above into three more or less petaloid branches; and the resultant fruit is a three-sided capsule, which splits longitudinally and loculicidally, *i.e.* through the midribs of the constituent carpels.

While the genus *Crocus* has six similar perianth-segments, in *Iris* and *Gladiolus* the two whorls are dissimilar; but, whilst *Gladiolus* is monosymmetric, *Iris* is polysymmetric, though the large petaloid extremities of its styles make it appear a somewhat puzzling flower for the tyro. Its inflorescence, technically known as a rhipidium, or heterodromous uniplanar unilateral cyme, certainly is complex. The flowers are produced, in succession, on short stalks in the axils of large sheathing bracts or spathes, which are green with membranous margins. If the second flower springs from the right-hand side of the base of the stalk of the first with its bract facing the two flowers, *i.e.* with its hollowed side towards them, the third flower will spring from the left-hand side of the base of the stalk of the second with its bract facing the other way, *i.e.* with its concavity towards that of the other bract. Similarly, the fourth flower springs from the right of the third, the fifth from the left of the fourth. This alternate branching is termed *heterodromous;* whilst as each branching is on one side only, it is *unilateral;* and, as all the flowers succeed one another in one plane, it is *uniplanar*.

The perianth forms a short tube below, and within it the nectar is secreted. Its three outer leaves or sepals are large and spread outwards and downwards, narrowing below into a channelled stalk-like portion. These "falls," as they are called by gardeners, have in many of our cultivated species a central "beard" or fringe of hair-like processes; but this is not the case with either of our wild British species. The petals are smaller and are also narrowed below with inrolled margins; but, as they stand nearly erect, they are known as the "standards."

The three stamens spring from the bases of the sepals, being technically epigynous and epiphyllous ; and in the centre of the flower a short, thick, three-sided style rises from the inferior ovary and divides into three broad petaloid segments, each of which arches outwards over a stamen and then bends upward into two triangular points. Just below the bifurcation of these two points a little ligule-like ledge projects over the anther and the upper surface of this is the stigma.

Long-tongued insects visiting the flower for its nectar alight on the spreading "fall" and are dusted over with pollen from the outward-curving and extrorse anthers. As these anthers are below the projecting ledge self-pollination can seldom occur ; but the insect on visiting a second blossom may well deposit some of the pollen with which it has been dusted on the stigmatic upper surface of the ledge. Bees are the chief pollinators, and it is stated that after pollination the little stigmatic ledge or flap is closed so that the pollen may not drop off, or that no further pollen may find access to the stigma.

The many-hued flowers of the various species, of which there are about a hundred, gained for the genus the name *Iris*, or rainbow, which is used by Theophrastus ; while the ease with which most of them can be cultivated has earned for them the modern soubriquet of "Poor man's Orchids." Even alongside the purples and whites of the magnificent Japanese *Iris lævigata*, our Yellow Flag is well worthy of cultivation in or near the water. Its names, whether scientific or popular, do not, however, suggest its beauty. *Pseudacorus* refers to the resemblance of its rhizome and foliage to those of the Sweet Sedge, *Acorus Calamus* L., which was considered useful in diseases of the eyes ; whilst the Early English "Livers," the Scandinavian "Flag," and apparently "Gladen" and "Sedge," all refer to the waving sword-like foliage. Like several other flowers which exhibit more than one shade of yellow, it is known in some counties as "Butter and Eggs" ; and the name "Cucumbers," which is applied to it in Devonshire from the resemblance of the large green unripe pods to young cucumbers, evinces, perhaps, rather more observation than the others.

Without entering upon the much controverted question of the origin of the "Fleur-de-lis," the "Lily" of France, which may once have represented three cobras, or the *Nelumbium* or Lotus of the Nile, or a true Lily, it may safely be said that the name has long been understood as belonging to an Iris. Though some of our earlier botanical writers certainly apply it to this Yellow Flag of ours, it is clear that Longfellow's

> "Beautiful lily, dwelling by still rivers,
> Or solitary mere,"

is some other species which combines blue with its gold, since he adds

> "Thou art the Iris, fair among the fairest,
> Who, armed with golden rod
> And winged with the celestial azure, bearest
> The message of some God."

XXIX.—ANALYTICAL DRAWINGS OF MONOCOTYLEDONS III.

AS the Natural System is an endeavour to express the relationships of plants as gathered, not from single characters, but from the totality of their structure, several Families are now classed in the Order *Liliifloræ* because they agree with the rest in most characters, although they have an inferior ovary and consequently epigynous insertion of the perianth and stamens. Among these, the *Amaryllidaceæ*, *Dioscoreaceæ*, and *Iridaceæ* are represented in our British flora.

Belonging mostly to dry subtropical regions, the seventy-five genera and seven hundred species of *Amaryllidaceæ* are represented with us only by the three genera here figured—the Snowdrops, Snowflakes, and Narcissi. They agree in being bulbous perennial plants with long, entire, sheathing, and generally sword-shaped radical leaves with parallel veins; whilst their inflorescence is a one-, or several-, flowered scape with showy flowers enclosed in membranous spathes. There are the two, three-leaved, petaloid perianth-whorls of most *Liliifloræ;* six stamens, the anthers of which in this Family are introrse; and three united carpels with numerous ovules on their central placentas. The fruits in these British genera are capsules which split *loculicidally*, *i.e.* down the midribs of their constituent carpels, thus breaking into the *loculus* or chamber of the ovary, the pericarp dividing into three valves. The ovules are anatropous or inverted, their elongated stalk or *funicle* adhering down one side of the seed as a somewhat fleshy *raphe*, while the embryo is short and straight and occupies the central line of the fleshy albumen.

Galanthus, the Snowdrop genus, is characterised by having two linear leaves; solitary, white flowers, which, though erect in the bud, protect their pollen and honey by drooping before they expand; spreading sepals and smaller, erect petals, notched at their apex and furnished with two honey-secreting green-lined grooves on their inner surfaces. The anthers are wider below, and converge into a cone round the style, each of them terminating in a stiff bristle-like point or *connective* and splitting by two slits down the upper part of its inner surface. The ovary is ovoid in form and remains green in the fruit-stage; and the simple tapering style projects beyond the cone of anthers. There are not many insects about at the season when the Snowdrop melts its way through the snow; but bees visiting the hanging blossoms can hardly fail to touch the projecting stigma, so parting with any pollen that may be already adherent to their heads, and then by touching the stiff connectives to shake the pollen out of the anthers. Anthers and stigma mature simultaneously; and, though the flowers remain expanded a long time on the chance of insects' visits, if these fail, the anthers separate and some pollen may fall on to the stigma of the same blossom.

In the first row of figures on our Plate, which represent the Snowdrop (*Galanthus nivalis* Linné), the first figure is a sepal; the second, a petal; the third, a petal as seen from within, showing the honey-grooves; the fourth, the

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essential organs, showing the style projecting beyond the cone of anthers ; the fifth, a young fruit surmounted by the withered remains of the perianth ; and the sixth, a transverse section across the ovary.

The genus *Leucojum* (the Snowflakes) differs in having more than two leaves, a double spathe, generally more than one flower on the scape, and the six perianth-leaves alike in form and size, white with a thickened green tip. The anthers have no connective-points, and the style is club-shaped. There is no excretion of honey in the flower ; but, as sugar occurs in the tissue of the perianth-leaves under the green spots, it is possible that, as in Orchids, some insect-visitors may delay to bore for it. The first figure in the second row on our Plate represents a flower of *Leucojum* in longitudinal section ; the second, the essential organs, showing the stamens arising divergently from an epigynous disk ; the third, the capsule dehiscing ; the fourth, the seed ; and the fifth, the same in section, showing the albumen and embryo.

The genus *Narcissus* may have flat or cylindric leaves and yellow or white flowers, solitary or several in an umbellate cluster. Its most distinctive feature is the perianth, in which the six sub-equal segments are united below into a tube, which is produced outwards as a cup-shaped or bell-shaped *corona* or coronet, generally differing in tint from the perianth-leaves. The six stamens are epiphyllous but do not project beyond the coronet.

Our British species (*Narcissus Pseudo-narcissus* Linné) has nearly flat, glaucous leaves ; a solitary yellow flower ; acute pale yellow perianth-segments ; and a bell-shaped, lemon-yellow coronet, as long as the perianth-segments, with a crisped and obscurely six-lobed margin. In the third row of figures on the Plate, the first shows a flower in longitudinal section ; the second, its essential organs ; the third, an unripe fruit, with withered perianth and spathe, of *Narcissus poeticus* L. ; the fourth, the same later ; and the fifth, a transverse section of it.

The small Family *Dioscoreaceæ* is mainly Tropical and consists of perennials with large tubers and annual twining aerial stems, net-veined leaves, and small inconspicuous diœcious blossoms. The genus *Tamus* comprises two species, both of which are European, characterised by red, three-chambered, few-seeded berries. In the penultimate row of figures on our Plate, the first two figures represent male and female flowers of our Black Bryony (*Tamus communis* Linné) ; the third shows the gynæceum ; the fourth, a ripe berry ; and the fifth, a longitudinal section through one.

The much larger and even more isolated Family *Iridaceæ* is largely subtropical, being especially abundant in South Africa ; but the genus *Iris* belongs to North Temperate regions. The yellow *Iris Pseudacorus* Linné is here represented first by one of its recurved outer perianth-leaves showing the honey-guides and a stamen, and secondly by a section through part of the flower exhibiting also the petaloid style and transverse linear stigma. The third figure shows the gynæceum ; the fourth, a longitudinal, and the fifth, a transverse, section through the same ; whilst the sixth is a seed.

XXX.—THE EARLY PURPLE ORCHIS.

Orchis mascula Linné.

THE last of the ten Orders into which, according to Engler's system, Monocotyledons are divided is the *Microspermæ*, so named from its minute and simple seeds (Greek μικρός, *mikros*, small ; σπέρμα, *sperma*, seed). In most other respects the small Tropical Family *Burmanniaceæ* and the great Orchid Family, which together constitute this Order, agree with those *Liliifloræ* as have an inferior ovary, such as the *Iridaceæ*. Though made up of three carpels, the ovary in the larger of these groups is only one-chambered, placentation being parietal, *i.e.* the margins of the carpellary leaves are not folded in to form a central axis. The parts of the flower are whorled or cyclic and typically consist of fifteen leaves in five whorls. The two outer whorls may both be petaloid, or may present a contrast of calyx and corolla; and six stamens may be traced by the vessels which would supply them with nutriment if they were fully developed. Four, or more commonly five, of them are, however, generally suppressed, and the one pollen-bearing stamen is united to the style in a central *column*. This and a great and varied modification in the form of the perianth-leaves, especially the posterior one in the inner whorl, produce a monosymmetry of the flower that at once distinguishes it from that of an Iris or other Liliifloral plant, so that their bizarre forms have earned for Orchids the description of "Irises run mad."

The most numerous Family of Monocotyledons, and one of the most widely distributed, the Orchids are considered, mainly on account of the complexity of their flowers, to be the highest Order in that Class, in spite of their having but a simple type of structure in their leaves and seeds. Most of the 5,000 or more species are Tropical, clinging by greyish-green aerial roots to the boughs of the trees, but deriving their nourishment from the moisture in the air. These epiphytes, as they are termed, have commonly short, fleshy, oval branches known as pseudo-bulbs, from the summits of which spring leaves and flower-stalks.

The Orchids of Temperate regions, such as our own, are, however, terrestrial, growing in the ground, especially on limestone soils, generally with two fleshy root-tubers. Their leaves are few in number, sheathing at the base, simple in outline, generally very glossy, parallel-veined, and sometimes marked with dark reddish spots.

In spite of the immense variety of form, size, and colouring presented by their blossoms, so that it has been said that there is scarcely a common reptile or insect to which one or other of them has not been compared, most Orchids conform to a very uniform type of floral structure. They have three outer perianth-leaves, or sepals, generally petaloid in texture and colour, and often alike. There are also three petals or inner floral leaves, but the lowest of these, the *labellum*, is most various in form and colour, serving usually as a landing-place for the insect visitants of the flowers.

The long pod-like ovary, which is sometimes twisted, is below the flower ; but as a rule it does not develop its numerous minute and simple ovules until after pollination. It is the twisting of the ovary that causes the labellum, originally the posterior or highest petal, to become anterior or lowest. In the centre of the flower is the column, consisting of the one stamen that is fully formed so as to produce pollen, united with the style ; and the pollen is often collected together into two club-shaped masses or pollinia, one in each anther-chamber, as may be seen by inserting the point of a pencil into the honey-containing spur, so as to imitate the proboscis of an insect.

It will be noticed that in some cases the bract is tinted with the same colour as the flower. Some of the sepals or petals are generally so placed as to form a protective hood over the central column, thus protecting the pollen and the stigma from rain ; whilst in *Orchis mascula* and many others the labellum is marked with rows of coloured dots or lines, which serve as honey-guides to the insect-visitors. It was thought, however, at one time that these insects were cheated, no nectar being produced, so that Orchids were even termed "sham nectar-producers." The fact is that the nectar is generally not, as in many other flowers, in the cavity of the spur, where we might expect it, but actually within its walls, so that the insect has to bore through the inner surface of the spur to obtain it. This delays the visitor for a time sufficient to allow the sticky cement at the base of the pollen-masses to dry and so firmly attach itself to the head of the insect. The two club-shaped pollen-masses thus removed from the flower very often bend forward or diverge, so that when the insect carries them to another blossom, instead of striking against the anther which occupies the same position as that from which they have been removed, they may strike upon the viscid stigma lower down at the entrance to the honey-spur. Each pollen-mass or pollinium is made up of many grains grouped together in little masses, of which again there are many in each of the club-shaped pollinia ; and so strong is the cement by which the whole mass is affixed to the insect that only part of these masses is torn off by the stigma and one pollinium may serve in this way to pollinate several successively-visited flowers.

This gaily-coloured and conspicuous species, often found in the midst of the Wild Hyacinths of our woodlands, was once known by a number of rural names. On the Scottish border, we are told, "children tell one another with mysterious awe that the root was once the thumb of some unburied murderer" ; whilst Shakespeare's "Dead Men's Fingers" is said to be still in use in Sussex. The curious Kentish "Skeat-legs" refers to the sheathing leaves on the stem ; whilst the more widely distributed "Bloody Man's Fingers" and the Cheshire "Gethsemane" obviously refer to the blood-like blotches on the lower leaves.

XXXI.—THE SWEET-SCENTED ORCHID.

Gymnadenia conopsea R. Brown.

ALTHOUGH he was not the author of any popular book, and his name is unknown to the general public, Robert Brown amply earned the title "Botanicorum facile princeps," bestowed upon him by Humboldt, by the variety, profundity, and importance of his researches. In no group of plants does a student realise the indebtedness of the science to Brown more than in the study of the *Orchidaceæ*.

Brown was born at Montrose in 1773 and studied at Aberdeen and Edinburgh. He was for a short time an army-surgeon ; but in 1801 was appointed naturalist to Flinders' Australian Expedition, from which he returned in 1805 with some 4,000 species of plants, mostly new to science. He then became librarian to Sir Joseph Banks and to the Linnean Society, and Banks on his death in 1820 bequeathed to him all his collections for his lifetime. They were, however, transferred by him to the British Museum, he becoming at the same time the first Keeper of the Botanical Department of the Museum, a post which he retained until his death in 1858. Brown was the first systematic botanist to combine the study of histology or microscopic anatomy with that of the more external characters upon which we base our classifications of plants. Not only did he discover the nucleus of the cell, but he also traced the structure and development of the ovule, the naked character of that of Gymnosperms, the coats, and the embryo-sac, and the main differences in that of Monocotyledons and Dicotyledons. No one had previously recognised the real significance of homology, or developmental identity, as distinguished from mere analogy, or external resemblance of form ; and it was the influence of his careful analyses of structure in various difficult groups, such as *Orchidaceæ*, that established the Natural System, in place of the artificial system of Linnæus, in England and in Germany. He worked out, as they had never been worked out before, the principle of symmetry in the flower, the method by which the relative position of its parts can be localised, and the explanation of the partial or complete loss of symmetry by the abortion or suppression of some parts or the unilateral growth of others. It was in 1831 that he first explained the general structural plan of the flowers of Orchids, tracing the vascular bundles of each of the fifteen floral leaves, recognising the inversion of the flower by the twisting of the ovary, and the putting out of pollen-tubes by the pollen-grains aggregated in pollinia. In the course of his anatomical study of the Family, Brown found it necessary to establish five new genera among British Orchids, of which *Gymnadenia* is one. We now recognise, in all, some 43 British species of the Family, in 18 genera, several species being, however, very rare, if not extinct.

Gymnadenia (from the Greek γυμνός, *gumnos*, naked ; ἀδήν, *aden*, a gland) is named from the fact that its two *retinacula*, or glands at the base of the pollinia which

serve to attach them to the head of an insect-visitor, are not enclosed in a pouch or *bursicle*, as they are in *Orchis*, but are naked.

The pre-Linnæan writers were chiefly impressed by the difference of the tubercles in this Sweet-scented Orchid from those of the Early Purple Orchis, and named it *Palmata* or *Palma-Christi ;* but Linné looked about for some insect to which he could compare its flower and, on account of the long spur, named it *conopsea*, the Gnat Orchis, from the Greek *κώνωψ*, *konops*, a gnat.

The ancient and widespread belief in the potency of the roots of the Mandrake to produce affection, alluded to in Genesis, seems connected with some magical doctrine of signatures, or the indication of the properties of plants by their external forms, like that which leads to the torturing of a waxen image to inflict evil on its original. This would seem to be connected in folk-lore with even the remotest resemblance to a human form, such as the palmate tubercles of *Gymnadenia* or other Orchids. The unequal size of the two tubercles in *Orchis mascula* has probably given rise to their name of "Adam and Eve"; but, perhaps, this name may have originally belonged rather to palmate tubercles, such as those of *O. maculata* L. or of *Gymnadenia*. So too the Scottish name "Love's Wanton" belongs, we are told, to these species indiscriminately. In Messrs. Britten and Holland's invaluable "Dictionary of English Plant-Names" it is said that

> "Rustics believe that if you take the proper half of the root of an orchis and get anyone of the opposite sex to eat it, it will produce a powerful affection for you, while the other half will produce as strong an aversion."

Gymnadenia conopsea has a hollow stem, unspotted, linear-lanceolate, acute leaves, and a long, narrow, many-flowered spike of blossoms. The ovate-acuminate bract below each flower is green and three-veined and about the same length as the ovary. The flowers are uniformly coloured, rose-red, lilac, or white, and have a delicious fragrance which is unusual in this Family and has been compared to that of the Clove Carnation, but, to my thinking, far more closely resembles that of Lilac. It is sometimes apparently scentless. The late Lord Avebury suggested that the white variety might prove attractive to moths, as the coloured forms undoubtedly do to butterflies.

The blossoms are about a third of an inch in diameter : their sepals and petals are alike coloured and obtuse, the two lateral sepals spreading widely, whilst the odd one and the lateral petals, which are nearly of equal size, slightly converge. The lip is rather deeply divided into three approximately equal, flat, rounded lobes and is covered with a fine down, whilst its spur is nearly twice as long as the ovary, very slender and curved, and is often half full of nectar. The anther is crimson and its two chambers are parallel. The linear retinacula of the pollinia are separated by the *rostellum*, a beak-like upward extension of the style, or rather a barren lobe of the stigma, the exact function of which is not in all cases clear.

XXXII.—THE GREATER BUTTERFLY ORCHIS.

Habenaria virescens Druce.

IN its name and in the details of its pollination this plant illustrates some points of interest common to many Orchids.

It must be admitted that the characters upon which Robert Brown separated the genus which Willdenow had named *Habenaria* (from the Latin *habena*, a thong, from the shape of the labellum) from *Orchis* appear but slight, so that some of Brown's contemporaries protested against his dismemberment of the latter genus. Of late years the cultivators of exotic Orchids have found that, contrary to what is usually the case among other plants, there is sufficient physiological identity in some sections of this Family to transcend the limits commonly assigned, on structural grounds, to the genera, and to permit interbreeding and the production of fertile hybrids, known as "bigeners," between individuals belonging to genera usually considered distinct. This might lead us to think that structural differences used to discriminate genera have, perhaps, been unduly emphasised. Those upon which Brown separated *Habenaria* from *Orchis* were the absence of any pouch or bursicle to hold the retinacula of the pollinia; the parallel or basally divergent position of the pollinia themselves; and the long spur.

A large number of northern species, both Tropical and Temperate, have been described as belonging to this genus, many of them with golden-yellow blossoms, and one, the Indian *H. longecalcarata*, with a spur four inches in length.

Linné described our two closely-related British forms, *H. virescens* Druce and *H. bifolia* Brown, under the one name *Orchis bifolia*, and the first botanist to name this larger form as a distinct species was Gaudin, who, in his "Flora Helvetica" in 1829, named it *Orchis virescens*. It was called *Habenaria chlorantha* by Babington in 1881, which name being pre-occupied was replaced by *H. chloroleuca* of Mr. Ridley in 1885, and erroneously by *H. montanum* Durand and Schinz in 1892. Finally, in accordance with our present rules, Mr. Druce restored Gaudin's original specific name in 1907. What is undoubtedly *H. bifolia* Brown is well described by Parkinson in his "Theatrum," in 1640, where he says that his

"fourth Ranke or order must comprehend all those sorts of *Orchides* whose flowers doe represent sundry sorts of insects, flyes, or other small creatures, which for their fruitefull generation were anciently dedicated to *Apis*, who was worshipped as a God at *Canope*, not farre from *Alexandria* in *Egypt*, and from thence took the name *Serapias*. . . .

"3. *Orchis Serapias bifolia vel trifolia minor*. The lesser twiblade or white Butterfly *Orchis* . . . hath two or three large leaves next the roote . . . the stalke is more than halfe a foote high, with two or three peeces thereon, and a small tuft or spike of white flowers at the toppe, thinly set thereon, somewhat resembling white butterflies with their wings spread, each flower having a crooked taile behind it full of a sweete liquor."

H. virescens Druce is described in the same place as "The greater Gnat flower," the two forms being readily distinguishable in Parkinson's figures by the slender pointed spur of the former (*H. bifolia*) and the thicker, blunt, club-shaped one in the latter (*H. virescens*).

The two tubercles of the root are ovoid, each tapering into a fibrous point, or, as Parkinson puts it, "like small turnips." The stem is angular; the two lower leaves are from three to six inches long, elliptical, tapering to a sheathing base, spreading, and of a lustrous unspotted green. A third, smaller, and more upright leaf is commonly present; whilst Parkinson's "peeces" are the lanceolate bracts on the lower part of the stem. The bract below each flower is only about the same length as the twisted inferior ovary and is green. The spike is generally lax, *i.e.* the flowers are not crowded together, and each blossom measures fully an inch from the tip of the odd sepal to that of the labellum. The three sepals spread widely and the whole flower is, as most of its specific names have suggested, tinged with a yellowish green. This colour is, however, accompanied by the delicious fragrance, so frequent among white flowers, which becomes much more powerful in the evening—an indication of the agency of crepuscular moths as fertilisers. The length of the spur, which is twice that of the ovary, *i.e.* from twenty to forty millimetres, is another indication of the dependence of the flower upon Lepidoptera for its pollination. The two petals are small, blunt, and "connivent," or converging in an arch, and the labellum of the third is straight, linear-oblong, blunt, entire, and rather longer than the sepals. The two anther-chambers are widely separated by the abrupt semicircular termination of the style and are twice as far asunder at the base as they are at their apex; but there is no rostellum between them. The pollen-masses are yellow, club-shaped, and have long caudicles and round retinacula. Darwin found that the adhesive matter on the retinaculum retains its adhesive property for twenty-four hours. While the pollinia slope backward their retinacula stand forward on either side of, and in advance of, the stigmatic surface. Each retinaculum is prolonged backwards into a short drum-like portion or "pedicel," as Darwin termed it, to which the caudicle of the pollinium is attached. This pedicel plays a very important part in pollination, since it contracts on one side on being removed from the anther, and thus brings the pollinium into such a position that it will strike the stigma of the next flower to which it is carried. The retinacula in this species attach themselves to the eyes or sides of the face of the visiting moths, whereas those of *H. bifolia*, the Lesser Butterfly Orchis, attach themselves to the base of the insect's proboscis.

XXXIII.—THE BEE ORCHIS.

Ophrys apifera Hudson.

IF in the cases of some other Orchids the resemblances to which they owe their names are but slight, the Bee Orchis strikes even the most casual observer by the remarkable closeness with which it mimicks the insect.

"Here," says Alphonse Karr, "is a little plant springing up in the grass to a height of five or six inches: its stalk ends in a pink flower; but what insect is that, with its head buried in the blossom, feasting apparently with such perseverance that it is motionless? Don't be afraid of frightening it, it won't fly away; for that insect is a flower: it is but the under part of these three lilac petals which surround it. The form, the colour, everything is perfectly imitated. You would not dare to touch it for fear of being stung. This flower which we may fancy we hear buzz, and upon which bees will not light believing it pre-occupied, this is the Bee Orchis."

In Isaac Disraeli's "Curiosities of Literature" is the following amusing instance of the danger of a little learning.

"Nature," he says, "has formed a bee, apparently feeding in the breast of the flower, with so much exactness, that it is impossible at a very small distance to distinguish the imposition. Langhorne elegantly notices its appearance:—

'See on that flow'ret's velvet breast,
How close the busy vagrant lies!
His thin-wrought plume, his downy breast,
The ambrosial gold that swells his thighs.
Perhaps his fragrant load may bind
His limbs;—we'll set the captive free—
I sought the living bee to find,
And found the picture of a bee.'

"The late Mr. Jackson, of Exeter, wrote to me on the subject:—'This orchis is common near our sea coasts; but instead of being exactly like a bee, it is not like it at all. It has a general resemblance to a fly, and by the help of the imagination may be supposed to be a fly pitched upon the flower. . . . An ingenious botanist, a stranger to me, after reading this article, was so kind as to send me specimens of the fly orchis, *Ophrys muscifera*, and of the bee orchis, *Ophrys apifera*. Their resemblance to these insects when in full flower is the most perfect conceivable; they are distinct plants.' The poetical eye of Langhorne was equally correct and fanciful; and that too of Jackson, who differed so positively. Many controversies have been carried on from a want of a little more knowledge; both parties prove to be right."

It is not surprising that the popular names of the plant all refer to this resemblance. They include "Humble-bee" and "Dumble-dor." The origin of its generic name *Ophrys*, from the Greek *ὀφρὺς*, *ophrus*, an eyebrow, is not so simple. Pliny asserts that some plant to which the name was applied was used as a hair-dye; but Sir Joseph Hooker suggests that the name has reference to the curved markings on the labellum.

Whilst in most Orchids we find elaborate contrivances to secure cross-pollination by insects, the Bee Orchis is, as Robert Brown first pointed out, a remarkable exception in being self-pollinating; so that there may be some foundation for his suggestion that its resemblance to a bee serves to warn off other bees from visiting it. It has, it is true, conspicuous blossoms and its pollen is united, as in so many other Orchids, into two club-shaped pollinia, as if to facilitate its being carried away, as it is in those other cases, on the head or proboscis of an insect, and so to pollinate another flower. Darwin, however—who by his work "On the various contrivances by which British and Foreign Orchids are fertilised by insects,"

published in 1862, did as much for the physiology or, as we now call it, the natural history of their flowers as Robert Brown had done, thirty years before, for their anatomy—showed, by repeated experiment, that pollen brought artificially from another flower of the same species has no fertilising effect upon the ovules, while he never saw an insect visit the flowers, and found in almost every case that seed was set as the result of self-pollination. The two anther-chambers split open soon after the flower expands, and the two pear-shaped pollinia, which have long, thin, flexible, weak stalks, or *caudicles*, fall forward over the stigma, to which the least breath of wind is sufficient to sway them. Darwin seems to think that, though the evidence is all against it, an occasional cross may occur ; but this would hardly suffice to explain all the gay colouring and elaborate structure. It seems as if Nature had altered her mind, so to say, and having contrived a whole group of flowers highly specialised for one purpose, viz. cross-pollination by insects, has made one in which, in spite of many such special structures, she has abandoned the main object for which they would seem to exist. In other words, whilst the ancestral type of *Orchidaceæ* may well have been entomophilous, the Bee Orchis is a degenerate harking back, physiologically though not structurally, to a yet earlier type. The plant is a variable one, and it would be interesting to learn whether all its many forms on the Continent are self-pollinating, or whether it is possible that the species has extended its distributional area beyond that of its insect fertilisers.

The Bee Orchis is one of a series of plants so frequent on warm, dry, chalky soils in the south-east of England that it has been thought to belong to a late migration into that region from the Continent or to absolutely require a calcareous soil. When it grows on the Upper Lias Clay, as it does in Gloucestershire, we have to remember that there is a good deal of lime in that clay ; but it has also been found occasionally on sandstones less likely to contain lime at some distance from a chalky locality. To such unusual spots its minute seeds may well have been carried by wind.

XXXIV.—LADY'S TRESSES.

Spiranthes spiralis C. Koch.

AMONG the voluminous artistic and scientific memoranda of that universal genius Leonardo da Vinci are many studies of the spiral. One of the most perfect of spiral staircases is reputed to have been designed by him, and in these memoranda we have, side by side with purely geometrical diagrams, beautiful drawings of the curves exhibited by living plants. Marvellous at once in their mathematical precision and in their resultant beauty are many of these natural spirals. The various spirals in which leaves succeed one another on shoots, or in which the florets of a Daisy or the stamens of *Magnolia* are crowded, or the spiral growth that produces the circumnutation of the shoots of twining plants, are less obvious than some spirals of external form. One of the *Hepaticæ*, *Riella helicophylla* Montagne, is a flattened, spirally-coiled thallus, and the abnormally flattened or "fasciated" stems of Teazles and other plants are frequently twisted in a spiral, as the result apparently of circumnutation. No more beautiful spirals are to be seen among plants than the inflorescences of the genus *Spiranthes*, named from the Greek σπεῖρα, *speira*, a spiral; ἄνθος, *anthos*, inflorescence.

As many as eighty species of this genus have been described, natives of Tropical and Temperate latitudes in the Northern Hemisphere, and we have three British species, the geographical distribution of which is noteworthy. *S. spiralis* C. Koch, the only common form, is unknown in Scotland, Northumberland, Cumberland, Durham, or the north of Ireland, and only occurs on the Continent from Denmark southward to North Africa. *S. æstivalis* Richard may once have been less rare, since it is now only known in such isolated bogs as those of Wyre Forest, Worcestershire, and the New Forest; but its Continental area is slightly more southern than that of *S. spiralis*, for it is unknown north of Belgium. Far more puzzling is the handsome *S. Romanzoffiana* Chamisso, which has been known for a century in Ireland, in boggy meadows, mostly not far from the coast, in Cork, Armagh, Antrim, and Londonderry, though otherwise only a native of North America and Kamtschatka. The only other species in our flora to which such an American origin is attributable are the little Pipe-wort, *Eriocaulon septangulare* Withering, which occurs in Skye and Connemara; the beautiful Blue-eyed Grass, *Sisyrinchium augustifolium* Miller, which occurs in Cork, Kerry, Clare, and Galway; and the even more puzzling *S. californicum* Aiton, found at Rosslare in 1896.

In all our British species of *Spiranthes* the root consists of two, three, or more tubercles, of a more or less cylindrical form; there are several radical leaves; the fragrant, white flowers are borne in the striking spirally-coiled spike; the lip is fringed but has no spur; the anther is hinged at its base to the back of the column and persists; there are four powdery pollinia united in pairs, without caulicles, attached to one retinaculum; and there is a rostellum, which becomes bifid.

S. spiralis has also been known by the appropriate name *S. autumnalis* Richard ; for it is in August and September that its pretty little flower-spikes may be found in dry pastures on a calcareous or gravelly soil. It grows from four to eight inches in height and its slender stem is slightly pubescent. The first leaves form a rosette just above the crown of the root and wither before the flowers begin to open. They are succeeded by a tuft of new leaves which spring from the base of the old stem. The leaves are about an inch long, ovate, acute, and slightly glaucous. There are several acuminate bracts on the lower part of the peduncle and each of the tiny blossoms—they are but a sixth of an inch across—is sheathed in a hollowed, abruptly-pointed bract. In this species the flowers form a single spiral which turns either from left to right, or from right to left ; but in *S. Romanzoffiana* the flowers form three parallel spirals—a most unusual arrangement.

The fragrance of the blossoms is very similar to that of the Butterfly Orchis or of Jasmine and, like that of so many other white flowers, is far greater in the evening. It has been extracted for the purposes of perfumery. Clarified fat is poured over the freshly-gathered blossoms and is then macerated in rectified spirits of wine.

The popular name "Lady's Tresses" is an obvious comparison of the spiral flower-spike to ringlets or plaits of hair. In the oldest form in which we have it the first word is apparently an abbreviation of the Old English possessive in -e, whilst the second is spelt "traces." This is in the very scarce little "Names of Herbes" by William Turner (1548), where he says :—

"A certeyne righte kynde of the same groweth besyde Syon, it bryngeth furth whyte floures in the ende of harueste, and it is called Lady traces."

Darwin's description of the complex mechanism of pollination in this species is very interesting ; but we can only give a summary of it.

The flowers project horizontally from the peduncle with the column in close contact with the fringed labellum, at the base of which the nectar is secreted. Below the backward sloping stigmatic surface a passage exists, "so narrow that only a fine bristle can be passed down it." Above and in front of the stigma is the flat tapering rostellum, along the middle line of which is a boat-shaped body, about one twenty-fifth of an inch in length, "filled with a thick, milky, extremely adhesive fluid, which, when exposed to the air, rapidly turns brown, and in about one minute sets quite hard." The rostellum itself "is endowed with a remarkable kind of irritability ; for if . . . touched very gently . . . it instantly splits along its whole length, and a little milky, adhesive fluid exudes." As the threads of the pollinia are attached to the upper surface of the boat-shaped body, they are withdrawn together by the insect-visitors, leaving the rostellum as a bifid process, resembling a tuning-fork.

The flowers expand from below upwards, as in most spikes, and Darwin observed that humble-bees visit the lower flowers first.

XXXV.—THE TWAY-BLADE.

Listera ovata Brown.

ONE of the commonest species in the Family, yet one of the most striking in appearance, the Tway-blade is less like the rest of our terrestrial Orchids than any other type, and in the mechanism of its pollination is termed by Darwin "one of the most remarkable in the whole Order." It is common in rich meadows, orchards, and copses, and these stations, together with the structure of the root, suggest that the plant prefers a certain amount of humus or leaf-mould in its soil.

There are no tubercles; but the premorse, ascending rhizome, or base of the stem, gives off long, slender, cylindrical, unbranched root-fibres, several together, throughout a considerable length. From this, ensheathed by one or two brown membranous leaf-sheaths, the stout, tapering, downy stem rises from one to two feet in height, its erect growth rendering an otherwise inconspicuous plant conspicuous.

At a point generally nearer the base than the apex of this stem spring the two leaves, which form so much the most striking feature of the plant as to have given rise to all its popular names and its older scientific designation. In "Tway-blade" and "Dufoil" we have apparently the Old English and the Norman-French equivalents of the *Bifolium* which we find in Dodoens and Lobel, and which is merely translated as "Herbe Bifoile" in Parkinson. The herbalist last named speaks of it as

"having onely two broad and short ribbed pale greene or hoary leaves, very like unto Plantane leaves but whiter set at the middle of the stalke one on each side, and compassing it at the bottome, sometimes it will get three leaves, which thereupon some reckoned to be a different sort, which is as we call it, but *lusus naturæ* by the abundance of nourishment in the plant, as it hapneth to very many other plants, (as to the *Herba Paris* as I said before, sometimes having five leaves, and sometimes sixe or seven, and sometimes wanting a leafe, when as ordinarily it hath but foure)."

The leaves are only sub-opposite, the sheathing base of one being below that of the other, and we have found three-leaved specimens either with three leaves with equal divergence of 120° or with the extra leaf below one of the normal two. The colour of the foliage varies according to the light to which it is exposed and differs but little from that of surrounding grasses. It has, however, generally a yellowish tinge. The leaves are broadly ovate, acute, downy, with none of the lustre so general among Monocotyledons, and with three, five, or more prominent longitudinal veins. These do not branch and anastomose in the Dicotyledonous manner; but are undoubtedly otherwise superficially like those of *Plantago*. They are from three to eight inches long.

In May, the inflorescence rises between the two leaves, forming a raceme of numerous, loosely-arranged green flowers, each shortly pedicellate and arising in the axil of a minute ovate-acute bract. Both pedicel and ovary are twisted so as to produce the same inversion of the flower as in most other Orchids. The sepals and petals spread outwards, the former a deep green, the latter a yellower shade, whilst the labellum is bent sharply downwards in a vertical direction and is divided into

two parallel strap-shaped lobes with a minute point between them. We have known this plant spoken of as the "Green Man Orchis" by those who, aware of the existence of a Man Orchis, were not acquainted with *Aceras anthropophora* Brown; but, in spite of the Grecian sage's definition of man as "a two-legged animal without feathers," arms are generally considered an essential part of a typical man, and *Listera* has no structures to represent arms, while *Aceras* has. Down the median line of the basal half of the labellum is a honey-secreting groove; and, whether the flower has, as has been suggested, some scent which is imperceptible by us, or not, insect-visitors are frequent, small beetles and flies more especially.

The column arches over the base of the labellum, having on its under side the two receptive stigmatic lobes and, between them, the flat leaf-like pointed rostellum. This is provided with a series of longitudinal tubes filled with a viscid milky fluid, and is most sensitively irritable, a touch by the thinnest human hair being sufficient to cause it to split across and exude some of the fluid. The two pollen-masses lie above the rostellum, protected by an arched hood-like termination of the column. They are each divided into two, but their retinacula are united, and the threads binding the grains together are so weak as to render the whole mass friable.

The *modus operandi* of insect-pollination can be easily imitated with the point of a pin. Darwin describes how the visiting insect alighting on the lip of one of the lower flowers of the raceme crawls up it, eating the nectar in its median groove till it passes the sharp bend. It then inevitably strikes the over-arching, irritable rostellum, and two drops of the exuded fluid drag with them the united pollinia and glue them firmly and immediately to the insect's head. The rostellum then curves suddenly downwards over the stigma to protect it from self-pollination and does not recover its position for some time. Thus this plant and *Spiranthes* are effectively protandrous. When the insect reaches flowers in the later stage at which the stigma is adhesive, the weakness of the threads binding together the pollen-grains permits a few of the *massulæ*, or groups of pollen-grains, to be torn from the pollinia, which may thus serve to pollinate several flowers in succession.

The seeds of *Listera* are noticeable, having the delicate transparent testa only a single cell in thickness, which is common among Orchids, drawn out into two long thread-like ends.

The genus was named by Robert Brown in honour of Dr. Martin Lister (1638-1712), a correspondent of Ray and an excellent all-round naturalist, best known, perhaps, for his work in conchology and entomology.

XXXVI.—THE BIRD'S-NEST ORCHID.

Neottia Nidus-avis Richard.

THE Family *Orchidaceæ* includes numerous examples of two types of abnormal nutrition. Most of the Tropical representatives of the Family are *epiphytes*, attached to, but not nourished by, the branches of trees and getting their food from the atmosphere and from accumulations of humus (dead bark and leaves), which often collect in large quantities in the shelf-like hollows between the clinging "air-plant" and the branch that supports it. Among the terrestrial Orchids it is probable that in many cases there is a *symbiosis* or partnership with a fungal mycelium or *mycorhiza*, by which the Orchid may be assisted in the acquisition of its necessary nitrogenous food-material. An Orchid with green leaves will manufacture its own carbonaceous food-material from the carbon-dioxide of the atmosphere, depending on the mycorhiza, perhaps, for nitrates. Where, however, as in the Bird's-nest Orchid (*Neottia Nidus-avis* Richard), the green colouring-matter (chlorophyll) is absent, the plant is dependent for the whole of its food-material, both carbonaceous and nitrogenous, upon the soil and the organisms in it. It is, perhaps, significant that, whilst many of our forest-trees have what is termed an *ectophytic* or *ectotrophic* mycorhiza (from the Greek ἐκτός, *ektos*, outside ; τροφή, *trophe*, nourishment), such Orchids as that with which we are dealing have one which is *endotrophic*, *i.e.* the mycelial threads of which actually penetrate the roots of the Flowering-plant. The fungus is probably able to absorb complex carbon-compounds from the soil and these it can hand on to the thin-walled internal cells of its host-plant, though they might be unable to pass through the thicker outer walls of its epidermis. Considering how closely the adaptations of parasitic plants resemble those of these saprophytes or humus-plants, it is not surprising that, until quite recently, these latter were thought to be parasitic. Both Sir James Edward Smith and Sir William Hooker are, however, careful to state that they could find no sign of attachment between the roots of the Bird's-nest Orchid and those of the trees at the foot of which it may be found. Just as the absence of a cambium or growing layer renders grafting practically impossible among Monocotyledons, so it may be doubted whether there is such a thing as true parasitism among Monocotyledons, *i.e.* a case of a Monocotyledon parasitically attached to another Flowering-plant.

These cases of abnormal nutrition are frequently accompanied by abnormalities or degeneracies in structure, and of this we have an example in those organs from which the Bird's-nest Orchid derives its names.

A wan, pallid, uniformly light-brown plant, by no means frequent, but found generally among dead Beech-leaves on a calcareous sub-soil, *Neottia Nidus-avis*, as Gerard says,

"hath many tangling rootes platted or crossed one over another verie intricately, which resembleth a crowes nest made of stickes,"

To Lyte and others the roots suggest the equally loosely-plaited nest of the goose, and both its Greek generic name, from *νεοττία*, *neottia*, a bird's-nest, and the Latin specific name *Nidus-avis* refer to the same structure. As Parkinson puts it,

"The *French* call it *Nid doiseau*, the *Germanes Marghen drehen*, the *Dutch Vogelsnest*, and we in *English* Birds nest or Goose nest, from the platting of the rootes like the stickes and strawes in a Crowes nest."

These roots have the very unusual habit of throwing off their root-caps, forming terminal buds and developing into shoots. This confusion to what many might think a fundamental morphological distinction has been also observed in the Aroid genus *Anthurium*.

The stem is solitary, erect, and unbranched, angular, hollow, and glabrous, of the brittle, juicy character common in shoots growing in shade, and about a foot high.

As the plant is independent both of solar energy and of atmospheric carbon-dioxide it has no need of leaves. The potential energy of the complex organic compounds received by means of its mycorhiza takes the place of light; therefore there is neither chlorophyll nor photosynthesis. The formation of its protoplasm can take place in any part of the plant, so that the main necessity for a transpiration current is removed. As in parasites, therefore, the leaves are represented only by a few sheathing membranous scales, which are, perhaps, merely vestigial.

The flowers are stalked and form a dense, cylindrical raceme, with small, oblong bracts. The sepals and petals are slightly incurved, and the lip is pouched at its base and cordately lobed at its apex. The nectariferous groove of *Listera* is replaced by a number of glands in the saccate region. The column is longer than in *Listera*, has no hood-like termination, and has a blunt rostellum, while the powdery yellow pollen-masses are the only relief to the monotonous brown hue of the whole plant. Flies seem to be the chief agents of pollination, and the mechanism is apparently much as in *Listera*.

Our less common Orchids are puzzlingly capricious in their numbers. In certain Beech-woods we can generally be certain to find a few specimens of this bizarre species in flower in June, or possibly in May or July; but on one memorable occasion we found a recently cut coppice, covering a good many acres, in which Bird's-nest Orchids were all but as abundant as are Blue-bells. Though the spot has been oft revisited, however, that sight of forty years ago has never been repeated.

XXXVII.—THE BROAD-LEAVED HELLEBORINE.

Epipactis latifolia Allioni.

THE British genera of Orchids can be conveniently grouped into four Tribes—*Ophrydeæ*, *Neottieæ*, *Malaxideæ*, and *Cypripedieæ*. Of these the first three have but one stamen bearing pollen, whereas *Cypripedium*, the Lady's-slipper, has two. The *Ophrydeæ* include *Orchis*, *Gymnadenia*, *Aceras*, *Neotinea*, *Habenaria*, *Ophrys*, and *Herminium*, four of which we have already exemplified. The *Malaxideæ* include the three genera, each represented in Britain by one bog species, *Malaxis*, *Liparis*, and *Corallorhiza ;* and the *Neottieæ* include *Goodyera*, *Spiranthes*, *Listera*, *Neottia*, *Epipactis*, and *Cephalanthera*. The first of these last six genera, only represented in our country by a rare northern species, *Goodyera repens* Brown, was appropriately named in honour of John Goodyer of Petersfield, a sixteenth-century botanist of whom too little is known. He appears to have been the first to discover some twenty-four British species and to have been, perhaps, the first botanist in England who can be termed "critical." Some manuscripts by him are preserved at Magdalen College, Oxford.

Whilst *Goodyera*, *Spiranthes*, *Listera*, and *Neottia* have a distinct rostellum with the anther hinged at the back of the column, the two related genera *Epipactis* and *Cephalanthera*, the species of which are alike known in English as Helleborines, have little or no rostellum and have the anther hinged on the top of the column, as is indicated by the name *Cephalanthera*, from the Greek κεφαλή, *kephale*, head, and ἄνθηρα, *anthera*, anther. Both of these two last-named genera are "Palæarctic" in distribution, extending, that is, from the Himalaya and Northern Africa over Asia and Europe ; and each comprises about ten species. The three British species of *Cephalanthera* are well-defined and beautiful plants, the commonest, *C. grandiflora* S. F. Gray, growing in copses on a calcareous soil, and bearing broad leaves and erect, cup-like, creamy-white, fragrant blossoms, the rarer *C. longifolia* Fritsch, with longer, narrower foliage, and the rarest *C. rubra* Richard, very similar but with rose-red flowers.

Epipactis, on the other hand, is a far more difficult genus. To begin with, there is considerable doubt as to the generic name it should bear. So vague and comprehensive was the Linnæan genus *Serapias* that the question at present rests between *Epipactis* and *Helleborine*. Both these names, it happens, occur in Dioscorides. *Epipactis*, obviously Greek, is of unknown meaning ; but seems to have been originally applied to some species of *Hellebore*. It was first used for Orchids by Haller (1708-77). *Helleborine*, otherwise spelt *Heleborine* and *Elleborine*, signifies resemblance to Hellebore (Greek ἑλεῖν, *helein*, to remove ; βορά, *bora*, food), the leaves of *Epipactis latifolia* Allioni bearing a considerable resemblance to those of *Veratrum album* L., the White Hellebore, a dangerous but once much employed emetic. Used by Dodoens, the Bauhins, Ray, and Tournefort, *Helleborine* rests,

as a post-Linnæan generic name, upon the "British Herbal" of the brilliant, if unprincipled, Sir John Hill, published in 1756. Its use in that work is, however, taken direct from Tournefort, and we do not consider that this work of Hill's can be considered as post-Linnæan.

Five fairly definite British species are distinguishable in this genus, although four of them are undoubtedly more closely related to one another than is the fifth, upon which ground Sir Joseph Hooker, in his "Student's Flora," made only two species, treating the four as three sub-species of *E. latifolia*.

Of these five, two seem to have been first recognised by John Goodyer. In Thomas Johnson's edition of Gerard's "Herball" (1633), p. 227, "Palma Christi, radice repente, Creeping Satyrion" is stated to grow plentifully "in a moist meadow named Woodmead, neere the path leading from Petersfield," and to have been found by Goodyer. This was probably *Epipactis longifolia* Allioni (*E. palustris* Crantz). On the following page Johnson writes :—

"I received out of Hampshire from my often remembered friend Master Goodyer this following description of a Nidus avis found by him the twenty-ninth of June, 1631. Nidus avis flore et caule violaceo purpureo-colore . . . The whole plant as it appeareth above grounde, both stalkes, leaves, and floures, is of a violet or deep purple colour. This I found wilde in the border of a field . . . a mile from a towne called Alton."

Sir J. E. Smith thought that this plant of Goodyer's was *Orobanche purpurea* Jacquin ; but we can well understand that the late Mr. Townsend when he found *Epipactis violacea* Boreau, on Selborne Hanger, in 1873, recognised, as we did on seeing it there in 1901, that this was undoubtedly Goodyer's "Nidus avis." The whole plant is as violet as *Neottia Nidus-avis* is brown, so that it has a strikingly distinct appearance.

The three remaining species are more closely similar. *E. atro-rubens* J. A. Schultes, a rare form, flowering in July, on certain limestone cliffs, has ovate leaves and flowers varying from a dark yellow to a blackish red. *E. media* Fries has long and narrow leaves and green flowers tinged with purple. *E. latifolia* Allioni has broad, ovate, strongly-ribbed leaves and flowers of much the same colouring as those of *E. media*, but with a small recurved point to its labellum. The terminal portion of the labellum moves as on a hinge, so that its rebound throws the wasps (which, according to Darwin, are the only insect-visitors) upwards against the rostellum. This at once becomes very viscid and cements the pollen to the insect. The genus differs from *Cephalanthera* in having stalked flowers, the pedicel being twisted, whilst the downy ovary is straight.

Darwin describes *E. latifolia* as one of the most abundant species of Orchids in the chalky upland woods of North Kent.

XXXVIII.—THE MARSH HELLEBORINE.

Epipactis longifolia Allioni.

A NEVER-ENDING subject for wonder in the study of plant-structure and plant-life is the manifold possibilities in the variants upon one type, whether in anatomy or in physiology. In no group is this variety in unity more remarkable than it is among Orchids. The many terrestrial representatives of the Family are all perennial and herbaceous and have more or less of a rhizome giving off fibrous roots, though in many cases, as we have seen, some of these roots are modified as food-reservoirs into tubercles. Their aerial stems are generally somewhat succulent or soft and juicy, with a glabrous and often polished surface ; and their leaves are simple in outline, sheathing at the base, distinctly parallel-veined, and also generally glabrous and polished. The inflorescence is in all cases racemose ; and (with the exception of the genus *Cypripedium*, the Ladies'-slipper Orchids) the flowers are constructed on a very uniform plan and are generally inverted by the twisting of the inferior ovary or the pedicel. Modified from the typically Monocotyledonous arrangement of fifteen floral leaves in five alternating whorls of three each, we find generally a petaloid perianth of three outer and often sub-equal leaves or sepals and three inner ones more distinctly bi-lateral in their symmetry to the median plane, the petal which is strictly posterior but from the inversion or *resupination* appears anterior, being a large landing-place for insect-visitors or *labellum*. By careful anatomical analysis traces of two stamens of the outer whorl may be detected as incorporated in this labellum, while the one *fertile* or pollen-bearing anther is the anterior one of this whorl, and very little trace remains of the inner whorl of three. Orchids can be recognised at a glance by the union of their essential organs into a central *column*, which earned for them Linné's descriptive term *gynandrous* (from the Greek γυνή, *gune*, a woman ; ἀνδρός, *andros*, of a man). In this structure the inferior, one-chambered, many-ovuled ovary is surmounted, with little or no style, by a tri-lobed stigma, two lobes of which become receptive, while the median one is modified into a peculiar structure known as the *rostellum* ; while the one pollen-bearing anther—the anterior one of the outer row—rises above this stigma, with no distinct filament. In most cases the pollen in each of the two chambers of this anther is united into a club-shaped mass or *pollinium*, the individual pollen-grains being tied together by elastic thread-like extensions of their coats into little packets or *massulæ*, the united threads from which unite into the stalk, known as the *caulicle* or *caudicle*, of the entire pollinium, which ends in a viscid body known as the *retinaculum*, attached more or less to the rostellum.

On this general plan we have a marvellous number of variations. Not only does the perianth vary in the size, colour, and markings of its leaves, but the form of the labellum more particularly seems almost infinitely varied. In the Tribe *Neottiniæ*, to which the Lady's Tresses, Tway-blade, Bird's-nest and Helleborine Orchids belong, there are more often numerous fleshy root-fibres than two tubercles ;

the successive annual shoots form a sympodial series, each ending in a terminal flower-spike (*acranthous*) ; and the pollen is somewhat loosely granular, the pollinia having no caudicles. The genus *Epipactis* is characterised by a leafy stem, twisted pedicels to the flowers, a straight ovary, an elastically hinged terminal lobe to the labellum, and the presence of two distinct linear petaloid staminodes—representing stamens of the inner whorl—one on either side of the column.

While several other species of the genus are fairly uniform and not very brilliant in the colouring of their blossoms, being often greenish or only tinged with red, the pretty Marsh Helleborine, which is often described as *Epipactis palustris* Crantz, is more gaily adorned. It seldom exceeds a foot in height : its long, narrow-pointed leaves give it the specific name it now bears : its sepals are green striped with red, and its petals white with a similar striping.

In physiology, however, there is greater discordance among Orchids than there is in floral plan. Leaving on one side the vast variety of epiphytic forms which adorn the boughs of lofty trees in the moist air of the Tropical jungle, we have, among terrestrial forms, the few brown saprophytic species, such as the Bird's-nest Orchid, and other less marked differences in habit. Many species, including most of the British representatives of the genus *Epipactis*, inhabit shallow beds of humus on a warm, dry, and generally calcareous sub-soil. Not a few, however, including the leafless saprophytic Coral-root (*Corallorhiza trifida* Chatelain), the local *Malaxis* and *Liparis*, the rare Summer Lady's Tresses (*Spiranthes æstivalis* Richard), and *Epipactis longifolia*, live in bogs or marshy places, sometimes among the Bog-mosses (*Sphagnum*). Whilst this last occurs in swamps on a limestone sub-soil, associated with Yellow Meadow-rue, Globe-flower, Marsh Marigold, Meadow-sweet, Grass of Parnassus, *Primula farinosa*, Jacob's-ladder, etc., it is also found in the alkaline waters of the fens of our eastern counties with Ragged Robin, Marsh Pennywort, Bog-bean, and Bladderworts. It would be interesting to have more precise knowledge as to its methods of nutrition, how far, for instance, it utilises humus.

XXXIX.—ANALYTICAL DRAWINGS OF THE ORCHID FAMILY.

(*Orchidaceæ.*)

VARIED as the nine preceding Plates show our British terrestrial Orchids to be in the size, colour, and general form of their flowers, they conform to a single structural plan. This is even true in the main for the whole five thousand species of the Orchids of the world. On the other hand, the Family presents some marked contrasts in methods of nutrition. Whilst all of the species are perennial and herbaceous, the majority of them are Tropical epiphytes, clinging in vast numbers and variety to the boughs of the lofty trees of the Tropical jungle, deriving much of their nourishment from the moisture of the air or the rotting bark and leaves alongside them, and storing some of it up in the swollen green *pseudo-bulbs* from which spring their leaves and flower-stalks. Of this type we have no British representatives, most of the Orchids of Temperate regions being *terrestrial*, growing, that is, on the ground.

Among terrestrial Orchids, however, there is more than one type of nutrition. The majority, as represented by eight out of our nine selected species, have green leaves, and roots partly fibrous and partly tuberculate. The nutriment, manufactured in the leaves from the material supplied by the roots from the soil and by the leaves themselves from the air, is stored up in the root-tubercles for use in the building up of future leaves, shoots, flowers, fruit, and seeds.

The Bird's-nest Orchid, on the other hand, is, as we have seen, a type of a very different kind of nutrition. With no root-tubercles, and in some other instances with no roots even, these saprophytic Orchids are more or less completely destitute of green colouring-matter, and have their leaves generally reduced to small brown scales. In these cases, by methods still very imperfectly understood, but probably in most cases by the help of a symbiotic fungus or mycorhiza, the Orchid takes in both carbonaceous and nitrogenous food in the form of soluble organic compounds from the dead leaves or humus in which it grows.

With these variations in methods of nutrition, the Family presents two types of floral structure. In all alike the flowers, if not one-flowered scapes, are arranged in bracteate racemes, or in spikes in which the inferior ovary may easily be mistaken for a pedicel or flower-stalk. In this Plate the first figure in each of the eight rows represents the floral bract. In some cases these bracts partake of the colour of the perianth, as in the Wild Hyacinth. With an inferior ovary, and with both whorls of the perianth more or less petaloid in texture, the flowers in their general scheme recall those of such *Amaryllidaceæ* as the Snowdrop, in which there is not the coronet of *Narcissus ;* but with three notable differences. First, the flower is mono-symmetric to the median plane, instead of being polysymmetric. Secondly, of the

two circles of three stamens each, present in the *Amaryllidaceæ*, only one stamen or the outer whorl, or two of the inner whorl, form pollen, the remaining five or four being aborted ; and, thirdly, the stamens are united with the gynæceum into a central column. To this condition Linné gave the name *gynandrous*, the Orchids being the major part of his Class *Gynandria*.

We have in England one very rare representative of the *Diandræ* or Sub-Family of the *Orchidaceæ* in which there are two pollen-bearing, or "fertile," stamens, viz. the Lady's-slipper Orchid (*Cypripedium Calceolus* Linné). This beautiful species, not here represented, now lingers in a few woods on limestone in Durham and Yorkshire. All other British Orchids belong to the late Professor Pfitzer's Sub-Family *Monandræ*, in which the one stamen perfectly developed is the median one in the outer whorl. This is originally anterior ; but the ovary is usually so twisted that it becomes posterior, whilst the *labellum*, or much modified posterior petal, becomes anterior. This reversal of the normal position is termed *resupination* and it results in the labellum acting as a landing-place for insect-visitors. In the first three types here figured the labellum has a spur ; and, perhaps, the fact that the nectar is within its walls, and has to be obtained by the insect boring the inner coat of the petal, may be connected with the long duration of the flowers, which may retain the receptivity of their stigmas for weeks.

In each row of figures the first figure represents the floral bract, the second a flower, natural size, seen in profile, and the third, the same seen (resupinate) from the front.

The first line of figures represents the Early Purple Orchis (*Orchis mascula* Linné), Fig. 4 being the column, with the two "posterior" petals, and Fig. 5 the stamen bursting so as to disclose the pollinia.

The second line is the Sweet-scented Orchid (*Gymnadenia conopsea* R. Brown).

The third line is the Greater Butterfly Orchis (*Habenaria virescens* Druce), Fig. 4 being a pollinium, natural size, and Fig. 5 one *in situ*, enlarged.

The fourth line represents the exceptionally self-pollinating Bee Orchis (*Ophrys apifera* Hudson), Fig. 4 being the pollinia falling forward from the anther, and Fig. 5 a longitudinal section through a flower.

The fifth line is the Tway-blade (*Listera ovata* R. Brown), Fig. 4 representing a fruit.

The sixth line is the brown saprophytic Bird's-nest Orchid (*Neottia Nidus-avis* Richard), Fig. 4 being the column, and Fig. 5 an enlargement of it.

The seventh line represents the Broad-leaved Helleborine (*Epipactis latifolia* Allioni), Fig. 4 being an enlarged view of the column from the front, and Fig. 5 a longitudinal section through the base of a flower.

In the last line representing the Marsh Helleborine (*Epipactis longifolia* Allioni), Fig. 4 is a fruit, Fig. 5 showing its mode of dehiscence.

Class II

DICOTYLEDONES

XL.—THE GOAT WILLOW.

Salix caprea Linné.

THERE is probably no genus of plants which more deserves the epithet "troublesome," applied to it by Sir Joseph Hooker, than does the genus *Salix*. This is not because there is any difficulty in recognising a plant as belonging to the genus. Willows range in size from small herbaceous plants to large trees. Their simple stipulate leaves vary much in outline and texture. They are all, however, diœcious: their staminate and carpellate flowers are both in catkins: the catkin-scales are not notched: there is no trace of a perianth, but there are honey-secreting glands in both male and female flowers; and the stamens are from two to five in number in the axil of each scale on the male catkin. The carpels are uniform in character, there being invariably two, united in a one-chambered ovary with two parietal placentas bearing numerous ovules. The ovary becomes a dry capsular fruit dehiscing into two valves and exposing a multitude of seeds each enveloped by a tuft of cottony hairs springing from its base.

The difficulty is in limiting and determining the species. Being diœcious, each species must have two forms, staminate and carpellate, and these often differ considerably in other characters than their catkins. There is unquestionably a very large amount of variation within the limits of each species, partly as the result of varying conditions of soil, exposure, temperature, etc. Hybridism occurs to a very large extent, even among Willows living under purely natural or wild conditions. In our withy-eyots or osier-beds we have also forms of foreign origin as well as our numerous native species. As some suggestion of the confusion thus produced in the minds of botanists, we may point out that Loudon described over two hundred forms as growing in the Saliceta which were not uncommon in his time; Sir William Hooker enumerated seventy species as British and Sir J. E. Smith, who denied hybridism, sixty-four species, besides three named varieties; Babington, Koch, and Lindley reduced the number of species to thirty, though the first-named authority also enumerated some fifty varieties; Andersson, who is followed by Sir Joseph Hooker and by the Rev. E. F. Linton, the latest monographer of our British forms, makes only eighteen British species; and Dr. Buchanan White only seventeen, nearly all the "varieties" of earlier writers being now recognised as hybrids of which the parentage has, in many cases, been determined.

The difficulty of the study of Willows arises partly from the necessity of collecting flowers and leaves at different seasons and partly from the varied changes which the trees undergo in pubescence, in shape of catkins, in the colour of the tips of the bracts, and in the length of the pedicel of the ovary, during the course of development.

Willows have apparently a geological antiquity nearly, if not quite, as great as that of Poplars, dating at least from Cretaceous times; and this, coupled with a

plasticity of constitution which is only less than their plasticity of form, has given them a wide geographical distribution. They belong mostly, however, to the Northern Hemisphere, and *S. caprea* belongs exclusively to Europe and Asia.

Mr. Linton subdivides the genus primarily by the bracts, which either remain of uniform colour, as in the Bay-leaved, Almond-leaved, Crack and White Willows, or become brown, blackish-brown, or red at their tips, as in the Sallows, most Dwarf Willows, and the Goat Willows. The species of the latter subdivision have only two stamens in each flower, which may be either united, as in the Purple Osiers, or distinct.

The Section *Capreæ* consists of small trees or shrubs with short branches which turn to a dull grey-brown. Their leaves are equitant, or folded down the midrib, with both edges of one outside both edges of the next, and are pubescent ; and their catkins are generally sessile, with a few small leaves at their base. In this Section, the Goat Willow is distinguishable from its near ally the Sallow (*Salix cinerea* L.) by its twigs, which are downy at first, becoming smooth, while its broad leaves remain softly pubescent beneath, whilst those of the Sallow usually become harsh.

Being among the earliest of the Willows to flower, the male and female catkins of these two species are the " Gold " and " Silver " Palms respectively of a March or an early April Easter. At this season the people of Guernsey will exclaim : "V'là le saue qui cattône " ; whilst in many parts of England they are called *Pussy-cats*, or the staminate ones, *Goslings*. The amount of pollen produced is very great, as in wind-pollinated flowers ; but the perfumed honey secreted by the small stalked gland at the base of the flower attracts many bees to collect the pollen, and the diœcism of the tree, of course, secures cross-pollination.

The name *caprea* refers to the reputed fondness of goats for the catkins. In the " Kreuter Buch " of Hieronymus Bock or Tragus (1546), whose name, by the way, means goat, the tree is represented with a goat stretching up to eat its catkins.

Unlike the Sallow (*S. cinerea* L.) and most other Willows, the Goat Willow flourishes in comparatively dry hedgerows and woodlands, a fact which we may correlate with the protection of its stomata from any excessive transpiration by the thick down on the leaves. It is not particular as to soil and occurs at all altitudes up to 2,500 feet above sea-level.

The grey foliage renders the tree conspicuous when not in blossom ; but, the leaves not being long and narrow as in the Willows familiar by the river-bank, many fail to recognise this species as a member of the genus. The tree is not utilised, as are many of its congeners, for wicker-work, cricket-bats, or other economic purpose.

XLI.—THE BOG MYRTLE.

Myrica Gale Linné.

ACCORDING to Engler's system of classification, Dicotyledons form two great series *Archichlamydeæ* (from the Greek ἀρχι, *archi*, primitive ; χλαμύς, *chlamus*, a cloak) and *Sympetalæ*. Both agree, of course, in the characters distinctive of all Dicotyledons, such as the two cotyledons, the ring of "open" vascular bundles in the stem, giving rise to a cambium, and, in perennials, to annual rings of wood, the complex net-veining of the leaves, and the predominance of five, four, or two in the number of leaves in the floral whorls.

The *Archichlamydeæ* have either (i) no perianth, (ii) a simple perianth of one whorl which may be either sepaloid or petaloid, (iii) a perianth of two whorls, of which at least the inner has its leaves disunited, (iv) a perianth in a few cases with the inner whorl gamophyllous, but closely related to polypetalous forms, or (v) a perianth of one whorl by the suppression of an inner whorl. Of thirty-two Orders of Dicotyledons, the "Cohorts" of some earlier systematists, twenty-three belong to the *Archichlamydeæ*. Of these, three only, the *Piperales*, *Proteales*, and *Opuntiales*, are without British representatives.

The consecutive grouping of the Orders in a single linear series is inevitably to some extent arbitrary, and it is extremely difficult to fix upon the most satisfactory succession. Taking the *Piperales* as the first, Engler considers the *Juglandales* as the second, a group characterised by exstipulate leaves, unisexual flowers, a one-chambered ovary, one ovule, generally erect, and a drupaceous fruit.

The genus *Myrica* constitutes almost the whole of a small Family (*Myricaceæ*) of somewhat uncertain affinities. A monotypic American genus, *Comptonia*, is the only other member of the Family. On the whole, it seems most nearly related to *Juglandaceæ*, the Walnut Family, with which it agrees in having a woody stem, scattered aromatic leaves, diclinous flowers, the staminate ones in catkins, a one-chambered, one-ovuled ovary, an erect ovule, a drupaceous fruit, and an exalbuminous seed. The main differences are that in *Myrica* the leaves are simple, the ovary is superior, and there is no trace of a perianth, whilst Walnuts have compound leaves and a perianth adherent to the consequently inferior ovary.

Myrica has been described in a fossil state from rocks of Cretaceous and of Tertiary age, and, though there are only about forty existing species, their world-wide distribution agrees with this indication that they are among the most primitive of Angiosperms.

Most of the species are shrubs, like our British representative of the group, but some of them grow into small trees. The bark contains resin, tannin, and benzoic acid, which give it astringent tonic properties, and, perhaps, account for the name "Wild Sumac" which we find applied to *Myrica Gale* in Henry Lyte's translation of

Dodoens's Herbal, the *Rhus sylvestris* of earlier writers. These substances also make it burn well, and Gerard says of it :—

"This gaule groweth plentifully in sundry places of England, as in the Isle of Elie, and in the Fennie countries thereabouts, whereof there is such store in that country, that they make fagots of it and sheaves, which they cal Gaule sheaves, to burne and heate their ovens."

The leaves are generally, as in our species, scattered, simple, serrate, leathery, exstipulate, and fragrant when bruised, or when the sun is hot, from the resinous glands with which they are dotted. Opinions differ as to whether such aromatic smells are pleasant or not, so that, whilst our species is commonly known as "Sweet Gale" and "Sweet Willow" and the plant is known in France as "Bois-sent-bon," it is also known as "Stinking Willow." The leaves are used as a substitute for hops in Sweden and in Yorkshire, and furnish a medicinal tea in rustic medicine, whilst Parkinson speaks of them as being formerly

"much used to be laid in Wardrobes, Chests, Presses, and the like, to keepe mothes from garments, and woollen cloathes as also to give them a good sent."

Though the name *Myrica* appears in Greek as μυρίκη, *murike*, for the Tamarisk, it is probably connected, as is the name Myrtle (μυρτός, *murtos*), with μύρον, *muron*, perfume.

The flowers are produced before the leaves, from May to July, and are sometimes monœcious though generally diœcious. The catkins form in the leaf-axils in summer and reach their full size by March, their scales being a shining red-brown and both anthers and styles red. Each staminate flower consists of four stamens in the axil of a bract. The powdery pollen is held between the catkin-scales until shaken out by wind. The spherical ovary is covered with resinous projections and surmounted by a bifurcating style ; and the small drupe which it forms becomes two-winged by the adhesion of the bract in the axil of which it is borne. The fruits excrete a considerable quantity of wax, which is separated by boiling them in water. *M. cerifera* L. thus obtained the name "Candle-berry Myrtle" in Canada and the United States, and *M. cordifolia* L. has been similarly employed in South Africa. The fruits of a Chinese species are eaten under the name "Yang-maes."

Few plants are more characteristic of stagnant water in boggy ground than is the Sweet Gale or Bog Myrtle. In Devonshire, swampy ground is termed "galey," and some moors in the west are known as "gale-moors." Upland moors, wet heaths, reed-swamps, and the "carr," or woodland formed on the margin of the fen, alike find it a home, and it is sometimes the dominant social species over considerable areas. It is, perhaps, more characteristic of acid than of alkaline peats, associated, as it is, with Alder, Cotton-sedges, Sphagnum-moss, Sundews, and such plants.

XLII.—THE HORNBEAM.

Carpinus Betulus Linné.

THE fourth Order of Dicotyledons is *Fagales*, comprising two principal Families, the *Betulaceæ* and the *Fagaceæ*. All of them are woody plants with scattered, simple, stipulate leaves, inconspicuous monœcious flowers, the staminate ones in catkins, an epigynous perianth, from two to six carpels, each containing one or two ovules, but only one seed usually perfect in the indehiscent nut-like fruit. Many of them, more tolerant of shade than the Willows and Poplars, are forest trees. The inflorescences are more or less reduced from an arrangement which is seen in its perfect development in some of the male catkins of the Sweet Chestnut (*Castanea sativa* Miller). In the axil of a catkin-scale, *i.e.* a bract, a flower is produced flanked by two bracteoles. In the axils of these two lateral flowers are produced, each again with two bracteoles, which will be in planes at right angles to those on the pedicel of the central flower. Finally, in the axils of these four bracteoles flowers originate, so that there are seven flowers and six bracteoles within the one catkin-scale. It is possible that while the inflorescences in various members of the Order have been reduced structurally from this type they have also become anemophilous instead of being, as their ancestors may have been, pollinated by insects.

The group is geologically ancient; but unfortunately we cannot trace its history with much certainty of detail. The *Betulaceæ* are characterised by having two one-ovuled carpels, but of the two ovules only one as a rule becomes a seed. The Family includes the Hornbeams, Hazels, Birches, and Alders.

Owing to a too general want of observation few of our native trees are so little known to the non-botanical public as the Hornbeam. It is abundant in our south-eastern counties, and probably formed a considerable proportion of the underwood of the great primeval forests of that region. It rejoices in a stiff, moist clay soil, but will grow also on gravel or on limestone. Its obovate resting-buds, closely adpressed to the branch, may unfold many years after their formation: accessory buds occur in the leaf-axils; and strictly adventitious ones are also freely formed from all parts of the tree. This enables it to repair the depredations of browsing animals or of the cutter of firewood; but, as its wood makes excellent fuel, there are few "spear" trees, individuals, that is, retaining the natural outline of the species, to be found. An unlopped Hornbeam, however, such as those in Richmond Park, may reach a height of seventy feet with a trunk nine feet in girth, and may form a much handsomer tree than most people are aware of, its boughs feathering to the ground like those of the Beech.

The stem is generally fluted, expanding below into buttress-like ridges; and, when pollarded, becomes flattened, "fasciated," or grown together, "inosculating," or dividing and re-uniting in a series of loops, gnarled and distorted into the grotesque caricatures of trees of which so many are to be seen in Epping Forest. The fluted

stem and some of the other irregularities in its outline is, in part at least, the result of its internal structure, the dense white wood being traversed by very wide rays and the annual rings between them taking a very irregular wavy direction. This, accompanied with the slow growth of a shade tree, makes its wood not only hard but also singularly tough, to which property it owes its name of Hornbeam (from the German *baum*, a tree) and its employment for cog-wheels, printers' rollers, and similar uses.

The thin grey bark shading to black, the buds and the leaves have some resemblances to those of the Beech ; but the Hornbeam buds are not as long as those of the Beech nor do they make the same angle with the stem. The leaves are of a hazel-green or slightly yellowish colour, have a tapering point, a serrate margin, and strongly-marked plaits along their pinnate lateral veins. As they unfold in April their stipular bud-scales are shed ; but, when the tree has been pollarded or clipped, the leaves themselves wither but do not fall in autumn. This makes the Hornbeam valuable as a wind-screen for hedges in nursery gardens, a use to which its modern German name, *Hainbuche*, refers.

The catkins appear soon after the unfolding of the leaf-buds ; the shorter carpellate ones terminating the shoots ; whilst the staminate ones, which have more prominent leafy catkin-scales than those of Hazel, hang from the axils of the leaves of the previous year. In the axil of each catkin-scale are from four to twelve deeply-forked stamens, each bearing two half-anthers surmounted by a tuft of hair. As no bracteoles are present it is doubtful how many flowers these stamens represent. The female catkin elongates considerably soon after pollination, and in the axil of each of its narrow green scales there are two lateral flowers and six bracteoles. The catkin-scales soon fall, but the bracteoles fused into two trilobed scales become large and green, performing at first the functions of leaves, and constituting as they hang in hop-like clusters one of the most marked features of the tree. In front of each is the two-chambered ovary, surmounted at first by two long red stigmas and by the five more persistent points of the adherent perianth. These last are clearly visible when the little three-sided and one-seeded nut has ripened and the brown and withered scales are ready to fall in October or November.

The etymology of the name *Carpinus* is doubtful. It has been traced to the Latin *carpentum*, a chariot, which seems borne out by the Swedish *karm* and the French *charme ;* but it has also been suggested that its source is the Celtic *car*, wood, and *pin*, a head, an equivalent for the Greek ζυγία, *zugia*, from the use of the tough wood in making yokes for oxen. The word itself is used by Pliny.

XLIII.—THE HAZEL.

Corylus Avellana Linné.

KNOWN to yield an edible seed in autumn, the Hazel is as familiar as the Hornbeam is the reverse. It seldom has the habit of a tree, sending up numerous suckers and branching freely from the base of its stems. The young twigs are of a rusty brown, with a soft down and blunt rounded buds ; but the bark on older stems becomes smooth and is marked by prominent transverse *lenticels*, or linear cork-warts, the channels of transpiration.

The Hazel is the earliest of our native trees and shrubs to come into flower, its catkins, formed during the preceding summer, opening in January, or even as early as October, though often not until March, while its leaves do not expand until the end of April or the beginning of May. Staminate and pistillate catkins occur on the same tree, but seldom reach maturity simultaneously, some trees being protandrous and others protogynous. The male or staminate catkins, to which the names "Cats'-tails" or "Lambs'-tails" properly belong, are pendulous, dull brown, sausage-like structures at first, borne four or five together on a "dwarf-shoot" or arrested branch, one terminal, the rest lateral. As they mature, however, they lengthen to two inches or more, becoming a pale greenish-yellow or primrose colour, and more decidedly green just after they have discharged their pollen. Each of the many small catkin-scales has in its axil two bracteoles, and four stamens so deeply bifurcate as to appear as eight. Each of the eight filaments terminates in a half anther tufted with hair, much as in the Hornbeam, and the whole structure probably represents a single tetrandrous flower. There is no perianth. Clouds of yellow pollen are shaken out by March gales, when there are no leaves on the trees to prevent it from being carried to the stigmas, and soon the empty catkins turn from green to brown and drop off.

The female flowers are grouped, eight to twelve together, in little egg-shaped, bud-like catkins, terminating dwarf-shoots, but apparently sessile on the upper side of a shoot. Each catkin consists of brown scales with silvery stipules, rudimentary foliage-leaves, and from four to six white, silky bracts, in the axil of each of which are two lateral flowers with the most minute six-toothed representation of the bracteoles. The flower itself is a minute two-chambered ovary, from the summit of which the two conspicuous crimson stigmas rise beyond the scales of the catkin. When the ovary begins to enlarge, after the wind has carried the pollen to its stigmas, a fringe-like perianth is perceptible round its summit, which will be recognisable as a circular line round the upper end of the green nut, and the rings of bracteoles grow out as the leafy husk or "cupule" which surrounds the base of the fruit. Meanwhile the dwarf-shoot elongates, so that the nuts when ripe are borne away from the parent branch on a leafy shoot. Only a few flowers of each female catkin will ultimately form nuts, and in each nut, as a rule, only one of the two ovules becomes a seed or kernel.

THE HAZEL—continued.

The Hazel is one of a small number of plants in which a remarkable method of fertilisation has been observed, known as *chalazogamy*. The pollen-tube, instead of entering the ovule, as in most Flowering Plants, by the little hole at its apex known as the *micropyle*, makes its way in near the structural base or *chalaza* of the ovule and thus reaches an extension of the embryo-sac. The significance of this remarkable process is not at present understood, but it may be a reversion to a very primitive mode of impregnation.

The leaves of the Hazel are three to four inches long, broadly ovate, heart-shaped, and somewhat one-sided at the base, with irregularly serrate margins, a long point, and a downy under surface. In the bud they are folded into several longitudinal plaits, and, when young, are of a bright, pleasing green. Later on they become woolly and of a dull brownish shade that is heavy in the landscape, until relieved by the autumnal changes into yellow, dull orange, or, as poor John Clare described them,

"Red as the glow that morning's opening warms."

The name *Corylus* is of Classical Greek origin but of uncertain etymology, though probably from κόρυς, *korus*, a cup, with reference to the leafy husk or "cupule" round the nut. The specific name *Avellana* is from the ancient Abella, now Avellino, in the Neapolitan Campania, where nuts are still much grown. This name has for us the additional interest of its association with that of the great English tree-planter, John Evelyn. He himself tells us that in some ancient records in his possession his ancestors' names were written Avelan; and it is, perhaps, a noteworthy coincidence that the fortunes of the family were made by the introduction of the making of gunpowder into England, and that Hazel was one of the chief woods used for the charcoal.

Cheap fishing-rods and excellent walking-sticks are cut from the Hazel, the latter sometimes spirally distorted by the twining of honeysuckle. Its coppice-shoots are also used for hoops round casks and for the baskets used in our northern collieries known as "corves." Wands of Hazel have frequently been found in the coffins of medieval ecclesiastics; but the most mystic import attaching to it is the supposed necessity that the forked stick, known as the "dowsing-rod" or, *par excellence*, as "the twig," used in that curious survival of ancient divination by which water, precious metals, or criminals are alike supposed to be detected, should be of Hazel.

XLIV.—THE BIRCH.

Betula alba Linné.

THE ancient idea of sex in plants, which Ruskin proposed to revive in nomenclature, was based upon the mere external appearance of vigour. Thus, in recognition, it would seem, of some affinity between Hornbeam and Birch, the masculine name *Betulus* was given to the former, while the feminine *Betula* was obviously appropriate to the elegant tree which Coleridge named "the Lady of the Woods." Whether it veils its black-banded silver stem, its coppery branches, and purple haze of twigs with emerald leaves and young catkins in April, or is hung with "patines of pure gold" in chill October, there is no gainsaying its pre-eminence in grace and beauty.

The name calls up many uses of former times and other lands, though now the tree is despised by the forester as a "weed," and is valued chiefly in this country by the lover of the picturesque. The very name Birch, in its connection with "bark," "barque," and "barge," suggests the age when its silver rind formed such canoes of our early British ancestors as have been found in the gravels of the Clyde, just as *B. papyracea* Aiton serves the Canadian Indian. At that period, no doubt, as now in Northern Russia, it served an infinity of other purposes. Its durable and impermeable bark is used for roofing and in the making of jars and boxes, or for tanning, a fragrant oil distilled from it giving its pleasant odour to Russian leather: its fibre furnishes cordage: the twigs are used throughout its area of distribution for brooms; and its wood for carriage-building, furniture, turnery, and fuel. Birch-wood spoons are used throughout Russia. The bark contains enough starch to furnish, when ground, a bread-stuff used by Kamtschadales and Samoiedes: the leaves are made into tea in Finland; and the copious sugar in the spring sap is fermented into wine in Leicestershire and distilled for spirit in Sweden. Salicylic acid is now obtained from an allied species; but this is a modern discovery, so that Turner can write in his "Herball" (1568) :—

"I have not red of any vertue it hath in physick; howbeit, it serveth for many good uses, and for none better than for betynge of stubborn boys, that either lye or will not learn."

A few years ago, a friend of the writer observed that the sugary sap flowing from a broken Birch bough in a Continental forest had by some air-borne germ been caused to ferment, so that some butterflies attracted to it had become helplessly intoxicated.

The genus *Betula* includes some thirty-five species, mainly confined to Northern Temperate and Arctic latitudes. No European tree extends so far north as does *Betula alba*, and it flourishes at an altitude of 2,500 feet in the Highlands of Scotland. Another species of the genus grows at 9,000 feet in the Himalaya. At these extreme limits of their range, such trees often dwindle to mere shrubs. In soil the Birch is not exacting: it flourishes in dry heaths, but is equally tolerant of

marshy ground or even of sour peaty soil. It is also remarkable for its power of holding its own, and even of spreading, amongst heather, where most other species are stifled. This, and its enormous seed-production, make it the speedy covering of northern forest clearings. At the same time, no forest tree so much requires light—a requirement reflected in its rapidity of growth and the slight shade that it casts.

It is in general a short-lived tree, seldom exceeding fifty feet in height, or a foot in diameter. The main stem extends tapering gradually to the summit of the tree, whilst its most striking characteristic is the flaking silvery bark. This polished rind will be noticed to be traversed at frequent intervals by transverse blackish ridges extending partly round the stem. These are the lenticels, which have stretched, as the stem has increased in girth, from mere spots into long lines. The Canadian Indian in making canoes or moccassins from the bark of *B. papyracea* has to sew up these gaps with fibre. The flaking of the bark is produced by the alternation of layers of large and small cells in the "periderm" or outer bark which is constantly being added to from an inner cork-cambium. The larger cells are more readily ruptured under the influence of variations in atmospheric moisture. This constant throwing off of its outer bark enables the Birch to withstand the smoky atmosphere of our cities.

Under Linné's *Betula alba* two distinct species are seemingly confused: *B. pendula* Roth and *B. tomentosa* Reith and Abel. These may, however, occur side by side and have thus become hybridised, and they seem also to have given rise to simple variations. *B. pendula* Roth, named later *B. verrucosa* by Ehrhart, has longer, more pendulous branches, with white resinous tubercles on their bark; and rhomboidally triangular leaves with straight bases, and veins projecting on the upper surface. *B. tomentosa* Reith and Abel, which is *B. glutinosa* of Fries or *B. pubescens* of Koch, is often a mere shrub and has rounded or heart-shaped bases to its leaves, with the veins projecting from their under surfaces.

The male catkins of the Birch are borne at the ends of the shoots of the previous year, generally in threes. Each catkin-scale has in its axil three flowers each with two sepals and two deeply-divided stamens, bearing four half-anthers without the tufts of hair that occur in Hornbeam and Hazel.

The female catkins are shorter and are, at first, erect. Here, too, there are three flowers in the axil of each scale. The scale coalesces with the two bracteoles into a small trilobed body, and the fruits have a relatively broad membranous wing. When they are ripe the whole female catkin falls to pieces.

XLV.—THE ALDER.

Alnus rotundifolia Miller.

THE Alders, of which there are some fourteen species, belonging mostly to North Temperate regions, differ from the Birches in the persistence of their woody catkin-scales as a little cone-like structure after the fruits have fallen. Our one British representative of the genus, *Alnus rotundifolia* Miller, is confined to the Palæarctic Region. Its distinctive feature is its roundish leaves, with their wedge-shaped base, wavy and toothed margin, short stalk, obtuse apex, and five to seven pairs of lateral veins—which become a glossily dark olive-green on both surfaces. These leaves are tristichous, the shoots bearing them being slightly triangular, as also is the cross section of the pith, whilst the glutinous hairy surface of the leaves when young gave the tree the name *A. glutinosa* Gaertner, by which it has long been known. Another prominent character is the short stalk that supports the oval resting-buds which, with the young twigs, vary from a greenish-brown to a red-brown, with a pronounced violet hue and a whitish resinous bloom.

Though it may reach a height of seventy feet and a girth of nine feet, it seldom exceeds half those dimensions. Gilpin in his "Forest Scenery" writes :—

> "He who would see the Alder in perfection must follow the banks of the Mole in Surrey, through the sweet vales of Dorking and Mickleham, into the groves of Esher. The Mole, indeed, is far from being a beautiful river ; it is a quiet and sluggish stream ; but what beauty it has it owes greatly to the Alder, which everywhere fringes its meadows, and in many places forms very pleasing scenes, especially in the vale between Box Hill and the high grounds of Norbury Park."

As its rich masses of young foliage overhang the golden beds of Marsh Marigolds, or, later in the year, it forms a background to foamy banks of Meadow-sweet, and the gorgeous magenta spikes of the Loosestrife, the Alder is certainly of value in the landscape ; but, as Sir Thomas Dick Lauder rightly says, when editing Gilpin's work, the species is as often associated with the more rugged scenery of Scottish glens. Some of the most striking individual trees which I know are a few gnarled, crooked, and round-headed standards, of no very exceptional size, in a mountain glen among the ancient Scots Firs of the forest of Ballochbuie, near Balmoral.

The Alder is more tolerant of stagnant water than any other European tree ; and this may be in part explained by its possession of numerous tubercles upon its roots, the work of a symbiotic Bacteroid by whose assistance the tree is enabled to utilise free atmospheric nitrogen. Like all water-side plants, it retains its leaves longer than the deciduous trees of dry situations, keeping them sometimes until January ; and, as they do not change colour in autumn, its winter verdure makes us appreciate it even more.

The bark of the larger stems is nearly black and is full of clefts, as was noticed by Virgil in the passage which Dryden translates—

> "As Alders in the spring the boles extend,
> And heave so fiercely that their bark they rend."

The live wood is white ; but when the Alder-holts are strewn in autumn with newly-felled stems it will be seen to turn red on exposure to the air, as if with blood, fading later to a permanent pale pink. It is exceptionally durable if kept either perfectly dry or under water, so, as Mr. Kipling writes,

"Alder for shoes
Do wise men choose" ;

though, to protect them from a boring beetle, French alder sabots are hardened by smoking. According to ancient tradition, to which Virgil refers, Alder was the first material employed by man for boats or "dug-outs" ; whilst Professor Martyn suggested that a hollow Alder floating in a stream may have in fact given to man the first suggestion of a boat. Both Pliny and Vitruvius mention the use of Alder wood for piles, the city of Ravenna and, according to Evelyn, the Rialto at Venice being founded upon piles of this material. Old knotty trees have a fine curled grain and the colour of Mahogany, so that the tree is said to be known in Ireland —where it is abundant—as Irish Mahogany ; but after long immersion in peat it becomes as black as Ebony.

In the angles of the larger lateral veins on the under surfaces of the leaves are little tufts of hair amongst which mites are often found. These have been supposed to devour fungus-spores which might otherwise injure the tree.

The catkins appear before the leaves, the cylindrical male ones, then about an inch in length, and green, being visible at the ends of the shoots, and the short ovoid female ones farther back, in the preceding autumn. In February or March the former lengthen to two or four inches and become a dark red until their shield-like scales, which protect the anthers from wind and rain, have shed the pollen, when they become rust-colour. The female cone-like catkins, though still green, have become three-quarters of an inch long in autumn ; but it is not until after pollination that they become brown and woody. There is no rule as to the relative dates of maturity of stamens and stigmas. Each male catkin-scale bears three flowers in its axil, each with four united green sepals and four superposed stamens with two-chambered anthers. The scales of the female "cone," on the other hand, have each two flowers each with two bracteoles ; and when, by September or October, the flowers have developed into little light-brown, winged and one-seeded fruits, these bracteoles have united with the catkin-scale to form one of the woody scales of the persisting fruit-cone. Not till the following spring do these scales gape asunder so as to enable the winged fruitlets to be dispersed by the wind.

XLVI.—THE BEECH.

Fagus sylvatica Linné.

THE *Fagaceæ*, with some six genera and three hundred and fifty species, differ from the *Betulaceæ* mainly in having three or more two-ovuled chambers to the ovary, although the nut is ultimately, as in the other Family, one-seeded. The cymose group of florets in the axil of each catkin-scale often consists of more than three flowers, and the fruits after fertilisation become surrounded by a cupule. This, in the Oaks surrounds one, in the Beeches two, and in the Chestnuts three, nuts; and there has been much controversy as to the morphological nature of this structure. The "cup" of the acorn appears like a cyclomic outgrowth from the stem, bearing numerous rudimentary leaves, which are replaced by the branch-like spines in the Chestnut and the recurved hooks in the Beech. At the same time, the splitting of the cupule into four in the two last-named genera supports the view that it is, at least in part, formed by the union of the four secondary bracteoles of the two lateral florets.

A group of undoubtedly great geological antiquity, and, perhaps, much reduced or degenerated in floral structure, the Family, and especially the genus *Fagus sensu latiore*, has at present a most remarkable geographical distribution. Whilst it is *sensu stricto* northern, only three species of Beech belong to that hemisphere, and a distinct sub-genus or genus *Nothofagus*, with a dozen species, is dispersed from Chile to Tasmania and New Zealand.

Considering that remains of Beech occur only in the more recent of the Danish peat-bogs, it is suggested that the species may be a comparatively recent migrant into England from the Continent; and that its shade-bearing and shade-casting nature has enabled it to establish itself as a dominant tree on warm light soils in the south-eastern counties, ousting the light-demanding Ash. It produces a spreading mass of roots but little below the surface which combine with its dense shade to kill most undergrowth. On sandy soils but little may be seen amongst its fallen leaves except Hollies, Whortleberries, and the silver-grey moss *Leucobryum glaucum* Schimper. An even more characteristic association of plants is that seen on steep slopes of chalk or limestone hills, where a shallow humus or leaf-mould can accumulate more readily apparently than on the hill-tops. Here Beechwood "hangers," as they are called, may exhibit a considerable mingling of Wild Cherry (*Prunus avium* L.) with an undergrowth of the shade-enduring Yew and Butcher's Broom. Before the Beech leaves unfold the ground may be sprinkled with the Wood Violet (*Viola Riviniana* Reichenbach), or a little later it may be carpeted with Dog's Mercury or Herb Paris, to be succeeded in turn by Sanicle or Wood-ruff. The stems of the Helleborine (*Cephalanthera grandiflora* S. F. Gray) may show themselves near the margins of the woodland, or in its darker recesses the brown saprophytic Bird's-nest Orchid, and *Monotropa Hypopitys* L. may appear above the russet fallen leaves.

Though they may vary in their powers of absorbing its products, all these are humus-loving species. The rootlets of the Beech itself are covered with a dense mycorhiza, which takes the place of its root-hairs, and hands on to the tree, perhaps, not only an abundant supply of water and soluble organic matter, both nitrogenous and non-nitrogenous, obtained from the humus, but also some of the free nitrogen of the atmosphere. It is at least significant that young Beech plants cannot be grown in artificial nutrient solutions or "water-cultures."

The buttresses at the base of the Beech do not extend far up the stem, which may rise in a cylindrical column twenty, thirty, or even seventy feet without a branch, or may have a girth of eighteen feet or more. From the main and approximately horizontal limbs huge branches may tower up vertically, "each in itself a tree," or the more slender branchlets and twigs may sweep downward to the ground. The smooth grey bark, from the time of Paris and Œnone to that of Orlando and Rosalind and onwards, has tempted to the carving of "many a long-forgotten name," as Campbell says; whilst its power of lateral growth, though enabling it to remain thin, first enlarges and then buries the incised letters :—

"Et quantum trunci, tantum mea nomina crescunt."

The long, polished and pointed, brown, spindle-shaped buds, diverging at a considerable angle from the dark grey twigs, are easily recognisable; though we may perchance notice a graceful little spirally-coiled snail-shell identical in size and colour with the Beech buds which is carried by its occupant, a species of *Clausilia*, at an angle similar to that made by the buds.

It is in April that the beauty of the Beech generally first commands our attention, when the swelling buds glow in the spring sunshine from bronze to red, and then first one spray and then whole trees burst into pellucid emerald silk-fringed foliage. A month later the globular heads of staminate flowers, each of which has from four to seven united sepals and from eight to twelve stamens, hang on long weak stalks among the leaves; whilst the green ovate cupule, covered with long tapering outgrowths and enclosing two female flowers, is borne on a shorter, stouter stalk nearer the apex of the same shoot. Neither type of flowers is at all conspicuous.

Each female flower has a perianth of four, six, or nine united sepals surmounting the three-chambered, three-styled ovary which becomes the three-sided nut so attractive to squirrels, dormice, pigeons, pheasants, and pigs. In spite of the many forest animals that feed upon them, plenty of these survive to put forth the curious, dark green, fan-shaped cotyledons with their white felted under surfaces.

XLVII.—THE OAK.

Quercus Robur Linné.

WHOLE volumes have been written on this tree, which we claim as a national emblem. Our navies built of its wood are as closely associated with our later history as were our bows of Yew with that of an earlier time ; and the distinctive form of its leaves and fruits render it the most familiar of British trees. The massive lines of the trunk sweeping upwards from the root are said to have suggested to Smeaton the design of his Eddystone Lighthouse ; while the huge limbs, spreading out fifty or sixty feet at a right angle to the stem, seem to defy the force of gravitation.

The shoots are generally short and slow-grown, angular with projecting leaf-bases, and changing from olive or yellow green to russet and silvery grey. They bear short, ovoid, five-sided buds, often of a warm reddish brown, either laterally or crowded three or more together at their apex. The frequent suppression of the terminal bud gives a characteristically tortuous or zigzag direction to the branching of the twigs ; and the arrest of the terminal internodes causes the leaves to originate in clusters at the apex of these branches. A pith pentagonal in section, as well as the five-sided buds, points to the pentastichous arrangement of the leaves. The buds are enclosed in twenty or thirty ciliate scales, which represent stipules, arranged in five rows, one at each angle of the bud, while in the centre are spirally-arranged conduplicate leaves each with two stipules. The leaves generally make their first appearance in the south of England towards the end of April, when the young shoots blush with a ruddiness almost autumnal; whilst a striking characteristic of the Oak is the production of fresh young growth, the so-called "Lammas shoots," late in the summer, especially if the spring foliage has suffered from weather or insect attack.

The leaves are mostly crowded together in tufts of three or more together near the apex of the shoot ; and, of the three varieties of our English species, *Quercus Robur* Linné, which have been described as distinct species, one—*Q. sessiliflora* Salisbury—has downy twigs ; petioles from half an inch to an inch in length; leaves more or less pubescent beneath and with somewhat triangular sub-acute lobes ; and the acorns close together on a very short stalk. *Q. intermedia* D. Don has both leaf-stalks and fruit-stalks short and a hoary stellate down on the under surface of the leaves ; whilst *Q. pedunculata* Ehrhart, the form represented in our Plate, has smooth twigs ; sub-sessile glabrous leaves with rounded obtuse lobes and an auriculate base, and the acorns scattered on a peduncle from one to six inches long. This last-named variety, the *Chêne blanc* of French foresters, is the most abundant form in our southern and midland counties, and generally reaches a less height before branching than does the Sessile-flowered Oak of the north and west. *Q. intermedia* D. Don, a dark-fruited variety in the New Forest, best, therefore, entitled to the name of

Durmast Oak, is said to retain its withered leaves longer into the spring and to have inferior timber resembling the wood of the Sweet Chestnut in appearance, and in being distasteful to spiders. The roofs of many medieval buildings in various parts of the country are traditionally but erroneously reputed to be of Chestnut. A cross cut of the wood of these timbers will show the conspicuous pith-rays which at once distinguish Oak wood from Chestnut.

The catkins of our Oaks appear shortly after the leaves : the staminate ones pendulous, the few-flowered female ones erect. The former are two or three inches long, bearing at intervals sessile clusters of inconspicuous flowers, each made up of a six- or seven-lobed hairy calyx and ten stamens with slender filaments. The female flowers, on the other hand, are solitary, each being surrounded by the numerous minute overlapping scales or bracts that are later on conspicuous on the exterior of the " cup " of the acorn. The flower itself is but the three chambered ovary with an adherent calyx and a style dividing above into three broad and spreading stigmatic lobes. Stamens and stigmas are thus well fitted for pollination by wind. In each of the three chambers of the ovary there are two ovules ; but of all six, only one, or sometimes two, become seeds. This reduction in the number of seeds as compared with that of the ovules is of frequent occurrence in many groups of trees, and suggests that such long-lived perennials, producing seed throughout a long series of years, require to produce far fewer in any one year to ensure the perpetuation and to maintain the number of individuals of their species than do annual plants.

The cup of the acorn is an important distinctive character among the three hundred species of Oak. In *Q. Robur* it is much shorter than the ripe acorn, and its numerous minute scales are triangular, obtuse, and closely adpressed. The interior of the cup is apparently an outgrowth from the axis. The name *acorn*, which is *ac corn*, the corn of the Oak, suggests a time when even the bitter fruit of our northern species may have been an important article of human food, as well as " pannage " for swine.

The bark, rich in tannin, has been largely replaced by cheaper but not superior materials for tanning ; but Oak timber, once almost the only wood employed in England for building ships and houses, fencing and furniture, is never likely to be superseded. Though neither the heaviest, the hardest, the toughest, nor, perhaps, the most durable of woods, it combines in an unequalled manner a high average in all these qualities.

XLVIII.—ANALYTICAL DRAWINGS OF CATKIN-BEARING TREES.

(*Salicaceæ*, *Myricaceæ*, *Betulaceæ*, and *Fagaceæ*.)

THE eight types here represented are now referred to four different Families and to three distinct Orders. These are the Order *Salicales* and Family *Salicaceæ*, the Order *Juglandales* represented by the Family *Myricaceæ*, and the Order *Fagales* including the Families *Betulaceæ* and *Fagaceæ*. They seem, however, to be all related, as was suggested by their former classification into the one group *Amentaceæ* or *Amentiferæ*, their flowers, inconspicuous individually but grouped into fairly conspicuous catkins, forming the obvious link between them.

Nearly all of them are woody plants, though some are quite small, especially those members of the group that characterise Arctic and alpine situations. Flowering before their leaves unfold and producing catkins which often sway in the spring breezes, the staminate ones discharging clouds of pollen and then falling, they are mostly obviously adapted to wind-pollination. At the same time, the branching of the catkin itself is by no means simple, and in a large proportion of these trees there is an adherent perianth and consequently an inferior ovary. These characters somewhat suggest degeneration from some higher type. The number of seeds matured is in this group commonly less than that of ovules originally present ; but this character seems distinctive rather of the tree form of perennial than of any particular ancestry or general degeneracy. On the other hand, the very general feature in the group known as *chalazogamy*, *i.e.* the entrance of the pollen-tube into the base of the ovule instead of the micropyle, does certainly suggest primitiveness. It might, however, be a reversion. Whatever be the origin of these Families, the general absence of a perianth, or its representation by a single whorl of minute leaves, serves to place them conveniently in the Sub-class *Archichlamydeæ*, just as formerly they were known as *Incompletæ*, *Achlamydeæ*, and *Monochlamydeæ* or *Apetalæ*.

The *Salicales* are stipulate and diœcious ; have no perianth ; and have two carpels united into a one-chambered ovary, forming a dehiscent capsule with many seeds. The *Juglandales* are exstipulate and have a drupaceous fruit with a single erect basal ovule. The *Fagales* have a perianth and are monœcious ; and have from two to six carpels with one or two ovules each ; but as a rule only one seed in the nut-like fruit.

Of the two Families included in the last-mentioned Order, *Betulaceæ* has two carpels ; *Fagaceæ*, three or more.

The first row of figures on our Plate are taken from the Goat Willow, *Salix caprea* Linné. Of these, the first is a single staminate flower enlarged, showing the entire hairy bract before it has turned colour at the tip, the two free stamens with their yellow anthers, and the nectary or honey-gland. The second is a female flower,

also enlarged, showing bract, stalked ovary, and nectary. The third is a fruit splitting from above into recurved valves, disclosing the hairy seeds : the fourth represents two seeds with the coma of hairs springing from their bases ; and the fifth, a cross section of the ovary showing ovules attached to two placentas.

The second row of figures represents *Myrica Gale* L., Fig. 1 being a male spike ; Fig. 2, the same enlarged ; Fig. 3, a female flower magnified ; Fig. 4, a staminate one, also magnified ; Fig. 5, a fruit, the resinous glands showing through its bracts ; and Fig. 6, the same in longitudinal section, showing the erect basal seed in the inferior ovary.

The third row of figures is the Hornbeam. The first figure is one of the long female catkins with the terminal crimson stigmas, natural size ; Fig. 2 is a staminate catkin with larger scales than those of Hazel ; Fig. 3 is a single catkin-scale enlarged, with stamens ; Fig. 4, a scale with one female flower ; Fig. 5, one of the bifurcate stamens ; Fig. 6, one of the trilobed fruiting scales formed by the cohesion of three bracteoles, natural size, with a nut showing the superior perianth and styles ; and Fig. 7, the nut in longitudinal section.

In line four, representing the Hazel, Fig. 1 is a male catkin ; Fig. 2, a female one, natural size ; Fig. 3, the same enlarged ; Fig. 4, one of its bracts, still more magnified, with a flower in its axil ; Fig. 5, a staminate flower ; Fig. 6, a catkin-scale with bracteoles ; Fig. 7, a cross section of the two-chambered ovary ; and Fig. 8, a ripe nut in its leafy cupule. This last is of natural size.

Line five is the Birch, Fig. 1 showing the smaller (female) and the larger (male) catkin on the same branch ; Fig. 2, a group of three diandrous flowers ; Fig. 3, a scale of the female catkin with two bracteoles and three flowers ; Fig. 4, a scale of the staminate catkin, with two scales or "sepals," seen from the outside and magnified ; and Fig. 5, one of the winged fruits enlarged.

Line six represents the Alder, Fig. 1 being a staminate catkin ; Fig. 2, three of the four sepals of a flower, with superposed stamens ; Fig. 3, a scale of a female catkin or "cone," with its two flowers and their bracteoles ; Fig. 4, a ripe "cone" ; Fig. 5, the same as seen in section ; and Fig. 6, a cross section of the young ovary.

The seventh row of figures is the Beech. Of these, Fig. 1 shows, natural size, a pendulous head of staminate flowers and the erect female catkin on the same branch ; Fig. 2 is an enlarged male, and Fig. 3, a female, flower ; Fig. 4 shows the triangular nut ; Fig. 5, the same in longitudinal section, when young ; and Fig. 6, the same in transverse section, when ripe, both somewhat enlarged.

The lowest line of figures on the Plate represents the Oak, Fig. 1 being a male, and Fig. 2, a female, flower, and Fig. 3, the latter in longitudinal section, all enlarged ; whilst Fig. 4 is an acorn, and Fig. 5, the longitudinal section of a seed, both natural size.

XLIX.—THE WYCH-ELM.

Ulmus glabra Hudson.

THE fifth Order of Dicotyledons is the *Urticales*, a very varied group of plants, the mutual relationship of which is somewhat doubtful in so far that their floral structures are of a reduced simple character, whilst they differ somewhat widely in such other characters as habit, latex, or milky juice, position and bending of the ovule, etc. They seem, however, to agree in having small green flowers arranged cymosely, their parts in whorls and usually dimerous, the stamens superposed to the perianth-leaves, and the ovary superior and uniovulate, forming an indehiscent achene or nut. The Order comprises three Families, the *Ulmaceæ*, *Moraceæ*, and *Urticaceæ*, having between them 109 genera and about 1,400 species.

The Family *Ulmaceæ* is a considerable group of trees and shrubs, mostly belonging to Northern Temperate regions, with a watery juice; distichous, simple, pinnately-veined, and often oblique, stipulate leaves; and perfect flowers with sepaloid persistent perianth and two united carpels, producing a solitary, pendulous, anatropous ovule, which becomes an exalbuminous seed with a straight embryo.

The genus *Ulmus* comprises some sixteen species, with mucilaginous, bitter, and astringent bark; rough foliage, with caducous stipules; flowers in small clusters, sessile on the sides of the twigs; and a flat ovoid samara or winged fruit, the wing in this case practically surrounding the seed-cavity. The flowers appear before the leaves and are each of them solitary in the axil of one of the clustered bracts. As in many wind-pollinated plants, the flowers are protogynous, the stigmas remaining receptive for a long time; and the filaments double in length just before the bursting of their anthers. Fertilisation is chalazogamic, and the samaroid fruit is obviously adapted to dispersal by wind.

The forms of Elm found growing in the hedgerows of southern England have been the despair of most botanists who have attempted to discriminate between them. Some striking characters have been found not to be constant even on two parts of the same tree. Such are the presence or absence of projecting ridges or "wings" of cork on the twigs, the size and form of the leaf, and the number of perianth-segments and stamens, numbers which vary together from four to five. On the other hand, there are characters which seem more constant and, therefore, more useful in the discrimination of species. These are the production or non-production of suckers; the shape of the fully-formed samara, whether obovate or sub-orbicular; the position of the seed-cavity or *loculus* with reference to the notch or *sinus* between the two apices of the wing, at the summit of the fruit, it being in some cases central and in others nearer to the sinus; and lastly the production or non-production of fertile seed.

From these characters and the less easily defined general habit or growth-form botanists have generally recognised two main groups of Elms in England and have thought that in so doing they were following the ancient Greek botanists and Linnæus.

These two types have long been known as the Common, English, or Hedgerow Elm, *Ulmus campestris* L., and the Scotch or Wych Elm, *Ulmus montana* Smith. They may be briefly characterised as being, on the one hand, a tree producing abundant suckers; long horizontal limbs, with a rounded head, often of great height; and obovate samaras, with sub-apical loculi and no fertile seed—this form being most prevalent to the south of the Trent; and a tree, more frequent in the north; without suckers, but with an open habit of growth; ascending, often drooping, branches; large, rough, markedly oblique leaves; and an orbicular samara, with a central seed-loculus and fertile seed.

It was formerly thought that the non-production of fertile seed by the Common Elm was an indication that it was not a native species. The copious production of suckers is an obviously compensating adaptation. As a matter of fact, however, the Common English Elm is only known on the Continent where it has been introduced from England.

Some recent experiments, made by Dr. Augustine Henry at Cambridge, seemed to show that we have in England two true fertile species of Elms and a series of hybrids between them; and that the Common barren hedgerow Elm of southern England is not a species but an early cross, preserved from extinction by its suckers and by the value which man has attached to its timber. Of its parents, Dr. Henry concluded that one was *U. nitens* Mœnch, a hedgerow species, producing suckers and small, thin, long-stalked leaves, smooth on the upper surface, with slender, nearly glabrous, twigs, becoming striated in the second year, and the seed-loculus near the apex of the samara; and the other was the Wych-Elm. Dr. Henry has, however, since abandoned this plausible explanation.

The Wych-Elm, the *U. montana* of Smith, is, I think, more accurately named *U. glabra* Hudson. As we have said, it seldom, if ever, produces suckers: its leaves are large, thick, rough but free from hairs, and short-stalked, and its seed-loculus is central; and Dr. Henry points out that its twigs are thick and pubescent, but become smooth in the second year.

The name "Wych" is probably the Early English "Hwæcce," the French "Huche," a chest, our modern "Hutch," the wood of this tree having been used in making many of the old linen-chests often mistaken for Oak; but a popular misunderstanding of the name has bestowed magic powers upon the tree, whilst a likeness in its leaves to those of the Hazel gave it the name of Wych-hazel, since transferred to the very different American genus, *Hamamelis*.

L.—THE HOP.

Humulus Lupulus Linné.

THOUGH now considered merely a Tribe of the large Family *Moraceæ*, the Hemps and Hops have generally been treated as a distinct Family, the *Cannabineæ*. Whilst most of the *Moraceæ*, the Mulberries, Figs, and Bread-fruits, are trees or shrubs with milky latex, the Hemps and Hops are herbaceous and have a watery juice. Their leaves are opposite and stipulate, their flowers minute, diœcious, pentamerous, and wind-pollinated, their stamens short and straight, and their solitary ovules anatropous.

The Hemp, though frequent as an outcast, has no claim to rank as an indigenous species ; but the Hop, though only introduced as a cultivated plant in 1524, was probably truly wild before that date.

Turner, in his " Names of Herbes," only twenty-four years later, says :—

" Hoppes do growe by hedges and busshes both set and unset."

The origin of Linné's generic name *Humulus* is uncertain ; but, derived from the Latin *humus*, the soil, it is suggested as either meaning low or mean, or that the long flexile stems would, without a support, lie prostrate. The specific name *Lupulus*, used generically by Brunfels, and, since his time, officinally, means " a little wolf," and comes from Pliny's " Lupus salictarius," the " willow-wolf," alluding to the tenacity with which the rasp-like " bine " of the Hop clings to willows, or, indeed, to any support neither too slender nor too large in girth to permit of its twining.

The Hop is a herbaceous perennial, with a stout, branching rhizome from which several aerial stems shoot up annually, rapidly attaining a length of fifteen or twenty feet. These are hollow, but are abundantly supplied with tough fibre like that of the allied Hemp, while their angularity and small hooked or anvil-shaped prickles give them a good grip of the support around which they twine by circumnutation. The long apical internodes swing round from left to right, or " counter-clockwise," on an average once in two hours and eight minutes. In the process the stem becomes repeatedly twisted on itself. The opposite leaves are stalked, cordate, coarsely-serrate, and palmately 3—5-lobed, bearing a general resemblance to those of the Grape-vine, but rough, especially on their under surfaces. They have two large membranous, interpetiolar stipules, which show by a notch at the apex that each consists of two connate ones belonging the one to one leaf and the other to the other. Some of the upper leaves may be unlobed.

The staminate flowers are borne in a much-branched, drooping, axillary, paniculate inflorescence, the plant that bears them being known in country parlance as a " seeder," a producer, that is, not of what the botanist terms seed, but of pollen. Each little flower consists of five small oblong, concave, obtuse, free

sepals and the same number of short epiphyllous stamens, with slender filaments and basi-fixed anthers opening by two terminal slit-like pores, so that the pollen only escapes a little at a time.

The pistillate flowers are produced in ovoid, cone-like catkins on slightly branched axillary shoots, the cone or "strobilus" being made up of broad, thin, concave, imbricate scales, in the axil of each of which are two naked ovaries each with a sheathing bracteole. Each ovary is surmounted by two long spreading, purple, downy stigmas which are mature at least two days before the anthers. A cup-like perianth grows up around the ovary, and the whole strobilus becomes much enlarged, reaching three times its size when in the flower stage and changing from green to yellow. Bracts, bracteoles, and ovary become thickly studded with yellow glands containing the waxy and resinous bitter principle known as *lupulin*. Each of these glands is a hemisphere with a truncated obconic base. The ovary becomes a small indehiscent nut or achene, containing one exalbuminous seed with a spirally-coiled embryo.

A few staminate plants used to be planted in every hop-field ; but it has been found that some male flowers are produced on the female plants, and it is believed, moreover, that the formation of lupulin, the valuable principle of the Hop, is independent of fertilisation. The plants flower in July and August and the strobiles are ripe for picking in September or October.

In brewing, Hops serve three distinct purposes : they give a bitter flavour to the sweet malt liquor ; check the acetous fermentation and thus enable the beer to be kept ; and clarify the liquid by precipitating the albuminous matter of the malt. Their pleasant and safe narcotic properties, which are brought out by heat, make a warm pillow stuffed with them useful in insomnia.

The "bine" or stem has been treated for the extraction of its fibre, either by prolonged steeping or by boiling in alkali and then rinsing in water and acetic acid ; and the leaves have been recommended as a fresh fodder for cows, being said to improve their milk-giving capacity. The tops are also eaten like Asparagus, which they precede in date. Since, however, Hops are a most exhausting crop, there is much to be said for the practice of burning the bine and restoring its ash, and the spent hops from the brewery, to the soil.

Humuleta, or hop-gardens, on the Continent of Europe, are mentioned in the eighth century ; and there is some evidence of the casual and private cultivation of the plant in England before its introduction on a large scale from Flanders in 1524. To hide sheds, or to cover arbours or trellis-work, the Hop can be easily grown in ordinary loam, preferring a sunny situation. There is also one other species in the genus, *H. japonicus* Siebold and Zuccarini, a vigorous large-leaved annual, which can be raised from seed sown in heat in March. Of this there is a variety with its leaves variegated with two shades of yellow.

LI.—THE SMALL NETTLE.

Urtica urens Linné.

THE considerable Family *Urticaceæ* was at one time so notoriously heterogeneous an assemblage as to be termed the "botanist's marine-store shop"; but the separation of *Ulmaceæ* and *Moraceæ*, and the careful grouping of the residue into Tribes, has removed this reproach to systematic botany. The Family now comprises some forty genera and over 450 species, the majority of which are Tropical. Europe, with fifteen species, is the poorest of the continents in variety; but, as Weddell observes, what it loses in this respect is partly compensated for by the multitude of individuals, so that there is perhaps no exaggeration in saying that the five or six species each of Nettles and Pellitories which swarm around our habitations cover nearly as much ground as the numerous species scattered through Equatorial regions.

Most species of the Family are herbs or undershrubs, though a few, such as the formidable *Laportea gigas* of Australia, reach the dimensions of trees. Their stems are often angular, with thin bark with a very tough fibrous inner layer or bast. Their juice is generally watery, and the whole plant is often hairy, the hairs being either simple or stinging ones. The leaves are stipulate and may be either opposite or scattered: the inflorescences are cymose and often "condensed" into capitula, with polygamous flowers, *i.e.* with perfect, staminate, and pistillate forms often on one plant; and the perianth is usually sepaloid, gamophyllous, and polysymmetric. The stamens, which equal the perianth-segments in number and are superposed to them, are characteristically curled inwards in the bud; their filaments are usually transversely wrinkled and uncoil elastically in flowering, the dorsifixed anthers dehiscing longitudinally and inwards with explosive violence. The ovary is one-chambered, with one erect uncurved ovule and the brush-like stigma usual among wind-pollinated plants: the fruit is an achene; and the seed has generally an oily endosperm.

The genus *Urtica* is mostly herbaceous and belongs mainly to Temperate regions. It derives its Classical Latin name from *uro*, I burn, with reference to the stinging hairs with which the whole plants are thickly covered, and several of the specific names, such as *stimulans*, *urens*, and *urentissima*, have reference to the same character. The stings are unicellular, epidermal hairs with a bulb-like base filled with formic acid. This poison reservoir is surrounded by other epidermal cells, so that the sting is generally borne up in a little papilla; its walls are strengthened with calcareous matter, but at the summit, separated from the calcified portion by an unthickened ring, is a minute hook-like knob the wall of which is silicified. On both stems and leaves the stinging hairs are slightly inclined upwards, *i.e.* towards the apex of the organ; so that if it be grasped from below they are merely laid flat, whilst the lightest brush against them in the opposite direction breaks off the little knob. This breaks with an oblique fracture, so forming a very sharp point, which will penetrate

the skin ; and the pressure of the epidermal cells surrounding the bulb-like reservoir forces the venom into the wound. Circulating protoplasmic matter can be readily observed with the microscope in these transparent and colourless stings, and it is suggested that the inflammatory character of the sting inflicted is due not merely to the strong acid but to an albuminoid toxin which is present. As Aaron Hill, an eighteenth-century versifier, put it—

"Tender-handed, stroke the nettle,
And it stings you for your pains ;
Grasp it like a man of mettle,
And it soft as silk remains."

The leaves are opposite and have each two free stipules ; whilst there is considerable variety in the essential organs of the flowers, some being in most cases perfect, though our largest British species is misleadingly named *U. dioica*. The perianth consists of four sepals, which are equal in the staminate flowers, but appear more obviously to be two pairs in the carpellate ones. The curved filaments seem peculiarly sensitive to the warmth of the morning sun. As they spring upwards and outwards, the anther turns inside out, so that puffs of the fine-grained pollen may be seen floating away on the breeze.

Nettle-tops, boiled in milk, make a broth or porridge still in repute in many parts of the country as a blood-purifier, and we have the testimony of Pepys's Diary, and of the constant use of it by Bewick the engraver, as to its excellence.

The tough fibre of the group is utilised in many countries, though the valuable Rhea or Grass-cloth is the product of one of the stingless Tribes of the Family. The poet Campbell writes :—

"I have slept in Nettle sheets, and dined off a Nettle table-cloth, and I have heard my mother say that she thought Nettle cloth more durable than any other linen."

In the Museum at Kew may be seen lace made from Nettle fibre in Ireland during the Famine.

Of our three English species of Stinging Nettle, the largest, *U. dioica* L., is perennial ; *U. pilulifera* L., the Roman Nettle, an annual species with its female flowers in little pill-like globular heads, is the most virulent ; whilst *U. urens* L., a more common annual form, is distinguished by the prominent longitudinal veins in its ovate-oblong, coarsely-serrate, bright green leaves and by its monœcious clusters of flowers.

All the species agree in their preference for the fine tilth and manured soil in the neighbourhood of human habitations, and their consequent close association with man has led to unfounded doubts as to their indigenous character.

The Red Admiral, Peacock, Small Tortoiseshell, Comma and Painted Lady Butterflies are among the many insects whose caterpillars feed on the Nettles, though they are most commonly found on *U. dioica*.

LII.—THE PELLITORY OF THE WALL.

Parietaria ramiflora Mœnch.

THE spreading tufts of this perennial plant, covered, as it is, with short curled hairs and often smothered in the dust of old mortar or of the neighbouring road, naturally suggest for it a name associated with those walls upon which it is almost invariably seen. It is, in fact, one of those plants inhabiting obviously artificial surroundings as to which we may be somewhat puzzled to imagine where it would have grown before man appeared upon this globe or learnt the art of building a wall. We are not surprised, therefore, to learn that its generic name *Parietaria*, or Wallwort, dates from Pliny, giving rise, by a medieval corruption, to *Parietorie* and *Pellitory;* that *Wallwort* itself occurs in the "Grete Herball" of 1526; or that the wholly vernacular *Lichwort* (the first half of which is the Celtic *llech*, a stone, which we probably have in such place-names as Leckhampton, the Lickey Hills, and, perhaps, the River Leach, running as it does through a region of flag-stones to its confluence with the Thames at Lechlade) is mentioned by Gerard. Another name, now assigned to an allied genus, is the Greek *Helxine* (from ἕλκω, *helko*, I drag), because, as Parkinson says, it adheres to one's clothes by the hairiness of its leaves and seeds. The same writer states that it was called *Perdicium* because partridges ate it eagerly, and *Vitrago* or *Vitriolaris herba*, "because the roughnesse thereof serveth to clense either pots or glasses." Perhaps, however, this latter name, with its German equivalent *Glaszkraut* and the Dutch *Glasseruidt*, may refer to some forgotten use in glass-manufacture, for the ash of the plant when burnt is stated to be rich in potassium-nitrate. Such names as *Herba muralis* or the Spanish *yerva de muro* clearly refer also to the plant's general habitat, as, perhaps, less directly, may the German *Saynt Peters kraut.*

The roots are long, slender, and tough, worming their way deeply into the mortar. There is a short woody rhizome, from which arise annual reddish, quadrangular stems, variously branched, tufted, erect or prostrate in direction. These are clothed throughout with numerous scattered, slenderly-stalked leaves, elliptic-lanceolate in outline, exstipulate, entire, more or less acute, with three chief longitudinal veins, and ranging from half an inch to three or four inches in length.

The *Parietaria officinalis* of Linnæus has been subdivided, the modern species being named from the direction of growth of their branches, *P. erecta* M. & K., which is apparently not British, and *P. diffusa* M. & K., now known by the earlier name *P. ramiflora* of Mœnch, which is. In addition to the direction of their branches and some minor differences of leaf-form, these two species are mainly to be discriminated by the bracts, which in *P. erecta* are free, but in *P. ramiflora* are united at their bases into an involucre still clearly formed of two three-lobed

segments. Each of these involucres is described as enclosing three flowers. When fully developed, however, each little axillary cluster is a polygamous cyme or glomerule of seven flowers. Of these, the central, terminal, or first-formed floret is carpellate. It originates in the axil of the primary bract and is flanked laterally by two free secondary bracts or *bracteoles*. It consists of four perianth-leaves united at the base into a tubular hairy calyx investing the one-chambered ovary, which is surmounted by a slender style thickening upwards and ending in a tufted, papillose, or brush-like typically wind-pollinated stigma. In the axil of each of its two bracteoles is a perfect flower again flanked by two bracteoles or tertiary bracts with flowers in their axils with two bracteoles each. Hence the two lateral groups of three flowers each have been described as surrounded by a seven-lobed involucre, *i.e.* by one secondary bract, two tertiary ones, and four quaternary. The two lateral perfect flowers each consist of a tubular, red, four-lobed, persistent calyx, which is hairy, and enlarges and hardens at a later stage ; four stamens, opposite the calyx-segments ; and a carpel. These flowers are exceedingly protogynous, the style protruding from the bud and the stigma becoming incapable of fertilisation, or even being shed, together with the style, before the anthers are mature. These flowers, therefore, when seen in their later stage, have been described as purely staminate. The stamens are much like those of the Nettles, their filaments being incurved in the bud, wrinkled transversely, and irritably elastic, and their anthers having two rounded distinct or "distant" chambers, which explosively turn inside out when mature, thus violently discharging a puff of light dust-like pollen. The four tertiary flowers of the glomerule may sometimes be entirely staminate, so that the inflorescence, comprising perfect, carpellate, and staminate blossoms, is termed *polygamous*. As in the Nettles, the explosion of the ripe anthers may be brought about by the slightest contact with any foreign body, or apparently merely by a ray of sunlight. As, however, the blossoms are destitute of honey or perfume, they are hardly likely to be visited by insects, unless for the sake of the pollen, and the explosiveness of the anthers would render this difficult for an insect to collect. No insect-visitors are, in fact, recorded ; and, although unexplained, the protogynous condition is very characteristic of anemophilous flowers.

The fruit is an indehiscent achene, enclosed within the enlarged persistent calyx, and contains one erect ovule.

The whole plant is mucilaginous and has formerly been used in medicine as an emollient, an infusion or tea made from it being then a favourite and innocuous, but by no means potent, rural medicine.

LIII.—THE MISTLETOE.

Viscum album Linné.

PARASITISM is generally accompanied by considerable structural degeneracy. It is difficult, therefore, in an Order such as the *Santalales*, the members of which are mostly parasites, to decide which characters are the results of such degeneracy and which may be evidences of primitive grade. There are, however, few characters common to all the six Families comprised in the Order. The parts of the flower are in whorls, the perianth generally of one whorl only and superior, the stamens superposed upon the perianth-leaves, and the carpels, one to three in number, syncarpous, inferior, and with one ovule in each.

Two Families are each represented by a single British species, the *Loranthaceæ* and the *Santalaceæ*.

The *Loranthaceæ* comprise upwards of five hundred species in more than twenty genera ; but the great majority of them are Tropical. Such heterophytic modes of life as climbing, epiphytism, and parasitism are all more frequent in the acute struggle for existence that characterises the dense vegetation of those latitudes. Most of the Family are evergreen shrubs, attached to the branches of their host-plants by means of suckers or *haustoria*, which seem to be structures of a very special character, though they have often been regarded merely as modified adventitious roots. As the leaves are green, these plants are not wholly parasitic, but probably depend upon the host-plant mainly for the water and dissolved saline substances that plants of normal nutrition (*autophytes*) obtain by their roots. The perianth consists only of a calyx, which is superior where an ovary is present, its sepals being *valvate* in the bud, touching, that is, without overlapping. The ovary is one-chambered and contains one erect seed with abundant fleshy albumen, and not infrequently more than one embryo. The thick radicle, or rudimentary tap-root, points towards the apex of the seed ; and the two cotyledons are blunt and fleshy.

The genus *Viscum* derives its name, which is used by Pliny, from the Greek ἰξός, *ixos*, or βισκός, *biskos*, which apply also to the bird-lime prepared from it. It forms no cork, but the epidermis of the stem persists and grows so as to accommodate itself to the increasing girth ; thus the stem remains smooth and green. Each bifurcation of these yellowish-green stems represents a year's growth.

The small, green, inconspicuous flowers are diœcious, being generally grouped in sessile cymose clusters of three at the apex of each branch ; and there is a slight difference in the shape of the blunt, 5—7-veined leaves in the two sexes, those on the male being slightly narrower. The flowers open from March to May and contain some honey, for the sake of which they are visited by flies and bees. There are four sepals, and in the male flowers the anthers adhere to them, and each has numerous pollen-sacs opening by separate minute pores to discharge the pollen, so that the surface of the anther resembles a honey-comb.

In the berries, which ripen in October, the seed fills the entire cavity of the ovary and adheres to its inner walls. These pearly white fruits, from which the species derives its name *album*, are eaten by many birds, especially the missel-thrush, fieldfare, and redwing ; but the extremely sticky layer of *viscin* which surrounds the seed prevents them from swallowing it, and they accordingly scrape it off their bills on a branch, where it may adhere and sprout.

It is remarkable that Mistletoe most commonly grows downwards, the seed in germination sending its tap-root upwards. This character formerly made it a rustic remedy against epilepsy, "the falling sickness." It occurs on a great variety of trees, but especially on the Apple, Poplar, Linden, and Hawthorn. It may grow upon exotic trees, such as the Robinia ; and even upon another plant of its own species. Upon the Oak, however, it is very rare, only about a score of "Mistletoe Oaks" being known in England, most of them in Herefordshire. Pliny, in his account of the Druidical veneration of the plant, apparently recognises this rarity.

"Calling it," he says, "in their own language 'all heal,' after their sacrifices and banquets have been duly prepared under the tree, they bring near two white bulls whose horns are then for the first time bound. The priest, clothed in a white robe, ascends the tree, and cuts the mistletoe with a golden hook ; and it is caught in a white mantle."

In Scandinavian mythology the name Mistletoe seems to be connected with "mist" in the sense of winter gloom. The story is that the happiness of the Æsir or chief gods depended upon the life of Baldur, the beautiful, the sun-god. Thereupon Baldur's mother Frigg exacted an oath from all minerals in the earth, all plants growing from it, and all animals, that they would not injure him. As Mistletoe does not grow out of the earth it was overlooked. Loki, the Evil One, envious of Baldur, made a dart of Mistletoe-wood ; and, when the Æsir were amusing themselves by shooting at the supposedly invulnerable Baldur, gave it to Hodi, the blind god of brute strength, and guided his aim, so that Baldur fell dead, pierced through by the fatal missile.

There is but little to connect the modern mystic use of the plant either with Druidical or Scandinavian legend. Possibly the evergreen character of the plant in the season of bare boughs suggests the reproductive powers of Nature, whilst its numerous clustering berries have a significance similar to that of the rice or confetti thrown after a newly-married couple.

LIV.—THE BASTARD TOAD-FLAX.

Thesium humifusum De Candolle.

THE small but widespread Family *Santalaceæ* are in many respects similar to the *Loranthaceæ*, and, like them, are partially parasitic, being either attached to the branches of other plants, as is the Mistletoe, or to their roots, as is this Bastard Toad-flax. The leaves are exstipulate, simple, entire, and generally scattered, and narrow. The small flowers may be solitary in the leaf-axils or in small cymose groups of three, just as in Mistletoe ; and, though generally perfect, may be unisexual. The sepaloid perianth may be perigynous or epigynous, and consists of from three to five lobes, which are valvate in the bud and have generally a tuft of hairs on the centre of their inner surfaces. The stamens are equal in number to the perianth-segments, to which they are attached by their short filaments ; but their anthers, though exceptionally four-chambered with terminal pores, are usually two-chambered and burst down the length of their inner faces. The ovary is inferior and one-chambered, though the lobing of the style and the presence of from two to five ovules are indicative of its being formed of several united carpels. The ovules are extremely simple, being entirely destitute of *coats* or *integuments*, and only one of them becomes a seed. They hang from the summit of an axis or placenta that rises from the base of the ovary.

The only important economic product of the Family is Sandal-wood, which is used for cabinet-work and carving, for incense and perfumery, and in medicine. It is the wood of the East Indian *Santalum album* Linné, and of allied Australasian species, which form large trees. One species, a native of Juan Fernandez, is now only represented apparently by a single tree.

The humble herbaceous root-parasites which form the genus *Thesium* constitute more than half the Family. The name is unquestionably derived from that of the Athenian hero Theseus. Games were held in his memory, and the θησεῖον, *theseion*, of the Greek botanist Theophrastus, seems to have been some plant which was used to form the crown that was competed for at these games. It is difficult to connect any such plant with the inconspicuous bearers of the name in modern botany. They are all slender, perennial root-parasites, with scattered, narrow leaves, and minute, whitish-green, perfect flowers, belonging mostly to the North Temperate regions of the Old World. The inflorescence is, at least primarily, racemose, and the bract below each flower is united to the flower-stalk, and, flanked by two bracteoles almost equalling it in size, forms what appears like a three-leaved involucre. The 4—5-lobed, tubular, adherent perianth or calyx persists in the fruit stage, and each lobe bears a stamen and a tuft of hairs at the base of its short filament. There is but a single style and a capitate stigma, and anthers and stigma mature simultaneously. Nectar is secreted at the base of the flower and the anthers on bursting remain open for some time, not apparently discharging all their pollen at

once. In wet weather, or if artificially moistened, they close. The one-seeded nut is ribbed externally, or rather the adherent persistent perianth-tube is so.

Our one British species, *T. humifusum* De Candolle, was included in Linné's *T. linophyllum*, so-called from its Flax-like leaves; and among earlier botanists it was known as *Linaria adulterina*, which has been translated by the book-name Bastard Toad-flax. Readily overlooked and not used in popular medicine, the plant cannot be said to have any real popular name. Unknown in Eastern or Northern Europe, it is also absent from Scotland and Ireland, being found, in fact, no farther north than Cambridgeshire and Norfolk. It grows in hilly pastures on chalk or oolitic limestone, in dry, sunny spots, and attaches itself to various plants.

It has a yellow, woody rhizome, the fibrous roots proceeding from which put forth little white knob-like *haustoria* or suckers. The aerial stems are numerous, and, as the name *humifusum* (given by the elder De Candolle in his "Flore Française" in 1815) indicates, they are prostrate, spreading out in a circle, and reaching six to eighteen inches in length. They are angular and are clothed with numerous slender, one-veined, linear leaves, about an inch long. The edges of the upper leaves, the bracts, and the pedicels are rough with minute denticulations. The flowers, which appear from May to July, are about one-sixth of an inch in diameter, and, though often solitary, are sometimes in cymose groups of three. The funnel-shaped perianth-tube is very short, and the triangular lobes of the limb have each a pair of minute teeth at their bases. They are green externally and white within. The green, ovoid fruit is longer than the persistent perianth, the segments of which are, at this stage, rolled inwards.

The Bastard Toad-flax was first recorded as a British plant by an excellent but little-known botanist of the beginning of the seventeenth century, John Goodyer, who lived in the neighbourhood of Petersfield, and seems to have been one of the first really critical students of species in England. He published no independent work, most of his observations appearing—as does the finding of the Bastard Toad-flax—in Thomas Johnson's edition of Gerard's "Herball," published in 1633.

LV.—SHEEP'S SORREL.

Rumex Acetosella Linné.

ENGLER'S ninth Order of Dicotyledons, the *Polygonales*, is co-extensive with the Family *Polygonaceæ*. This is an extensive group of plants, mainly herbaceous and belonging to the North Temperate Zone, and includes three or four well-known genera: *Rumex*, the Docks and Sorrels; *Polygonum*, the Knot-grasses; *Fagopyrum*, the Buckwheats; and *Rheum*, the Rhubarbs. Among the chief characters in which they agree are those of the leaves and their stipules and those of the ovary and ovule and the resultant fruit and seed. The leaves are scattered, simple, revolute in the bud, with sheathing petioles and *ochreate* stipules, that is to say that the two stipules, which are generally membranous, are united by both margins so as to form a sheath round the stem. Though the perianth persists round the fruit, the ovary is superior and is not adherent to it, and almost always forms a triangular nut, one-chambered and containing one erect unbent ovule springing from its base and forming a seed with floury albumen. The flowers are usually perfect and polysymmetric and generally small, but often so massed as to form handsome inflorescences; and, since they generally secrete nectar, they are mostly, but by no means universally, insect-pollinated. In the fruiting stage the persistent perianth generally forms a membranous wing, so that dispersal by wind is facilitated; but in some members of the Family the fruits are provided with hooks so as to form burs to adhere to the coats of passing animals.

The underground parts of some species are astringent or purgative, and the green parts are often very rich in oxalic and malic acids, chiefly probably in the form of acid binoxalate and malate of potash. This renders some of them useful as vegetables, though others are too pungent; and possibly this acidity of their sap may be connected with the red colouring-matter with which the stems, leaves, and perianths of many members of the group are deeply tinged.

An important distinctive character within the Family is the arrangement of the perianth-leaves, which may be either *cyclic*, that is in whorls, in this case of three leaves each, or *acyclic*, that is in a spiral, when they are generally five in number. The two large genera *Rumex* and *Polygonum* belong to these two Sub-Families, which have been termed *Rumicoideæ* and *Polygonoideæ*.

The names of the genus *Rumex* have an interesting history. *Rumex* itself is supposed to be the name of some kind of spear, the pointed *hastate*, or halberd-shaped, leaves being strikingly characteristic of many of the species. Pliny makes use of the name, but speaks of the acid-leaved Sorrels, such as *Rumex Acetosa* Linné and *R. Acetosella* Linné, under the name *Oxalis*. This name remains in Lobel and Gerard. The former writes of our Sheep's Sorrel in 1570 :—

"Oxalis tenuifolia—Oseille de brebis . . . tanto luxu sabulosis . . . Angliæ oportuna."

The old Greek name λάπαθον, *lapathon*, became the Latin *lapathum* and the Italian *lapazio*, and this last being mistaken for *la Passio*, the Passion of Our Lord, the plant got the names of *Patientia* and *Patience*. The name *Dock* is the Early English *docce*, the Danish *dukke*, meaning a bunch or flock of flax or hemp, the equivalent of the French *bourre*. This was first applied to the Burdocks (*Arctium*), the burs of which are often entangled in wool, and seems to have been afterwards extended to any broad-leaved plants. As to *Sorrel* and the Scottish *Sourack*, they are simply the Teutonic equivalents of the Latin *Oxalis* and the French *Oseille*, meaning sour or acid, as also does the officinal *Acetosella*. The prefix "Sheep's" was, no doubt, suggested by the abundance of the small *Rumex Acetosella* Linné on sandy uplands where sheep are pastured.

The genus *Rumex* comprises biennial and perennial herbs with stout tapering rhizomes and usually fluted aerial stems. The flowers are arranged in whorls on a raceme or panicle and are cyclic, the perianth consisting of two alternating whorls of three leaves each, the two whorls differing but little in texture or colour, though the inner enlarges considerably in the fruiting stage. Both are commonly deeply tinged with red. Stamens and carpels may be present in the same flower or may be monœciously or diœciously separated. There are six stamens with short, slender filaments and basifixed anthers ; but their position, in pairs alternating with the inner perianth-leaves, suggests that they are really three branching. The three-sided ovary is surmounted by three slender styles spreading horizontally between the inner perianth-leaves and terminating in tufted stigmas, indicative of wind-pollination.

The British representatives of the genus may be divided into two groups : the Docks, without hastate auricles to their leaves and with flowers almost always perfect ; and the Sorrels, with hastate or sagittate leaves and monœcious, diœcious, or polygamous flowers. The Sheep's Sorrel (*R. Acetosella* Linné) is a small plant, the whole of which is often tinged, especially in autumn, with a deep red. Its hastate leaves have silvery stipules. The flowers are some of them perfect, others carpellate ; but those produced at the beginning of the season are protogynous, as is so often the case with wind-pollinated blossoms, whilst those produced later are *homogamous* or *synacmic*, *i.e.* have stamens and stigmas maturing simultaneously.

The plant is very common on sandy, gravelly, and other siliceous soils, being often associated with heather, whortleberries, or such grasses as *Nardus stricta* L. and *Agrostis*.

LVI.—THE AMPHIBIOUS PERSICARIA.

Polygonum amphibium Linné.

THE genus *Polygonum*, which gives a name to a Sub-Family, a Family, and an Order, is itself appropriately named from the many "knees" or bent and swollen nodes in the stems of many of its hundred and fifty species, from the Greek πολύς, *polus*, many ; γόνυ, *gonu*, knee. The same character is the origin of the English name *Knot-grass*, which is borne by many species, the German *Knöterich*.

Although all the species are herbaceous, they exhibit a great variety in the adaptations of their vegetative structures to many different conditions of life. In Northern Asia there are several large rapidly-growing forms, the stout aerial stems of which, with taper-pointed leaves and foamy masses of cream-white blossoms, are now familiar objects in our shrubberies. *P. baldschuanicum* Regel is an attractive climber, with slender quick-growing stems, heart-shaped leaves, and a profusion of flowers. Other species are xerophytic, and others again more or less completely aquatic. Some of them are polymorphic, as are our Common Knot-grass (*P. aviculare* Linné) and *P. amphibium* Linné, adapting themselves temporarily to varying conditions but often resuming their earlier form if these conditions are reversed. In some, nectar is secreted by the flowers, and they are mainly dependent upon insects for pollination : others are homogamous and at least sometimes self-pollinating. Others again rarely ripen their seed, multiplying vegetatively; or produce *cleistogamic* flowers that do not open ; or bear bulbils in lieu of blossoms.

The leaves in all are scattered and have tubular *ochreate* stipules, while a resemblance in form shown by the leaves of some species to those of the Peach has earned for the group the name *Persicaria*.

The flowers are individually small, and may be solitary in the leaf-axils or in cymose clusters arranged in spikes or much-branched panicles. They are mostly perfect and have a white or pink acyclic perianth of five united persistent leaves, of which the three outermost sometimes enlarge in the fruiting stage. The stamens also form a spiral series, five, six, seven or, most commonly, eight in number, with very short, subulate filaments and roundish, versatile anthers. The four outer stamens in the spiral probably represent branched forms, so that the number is really the same as that of the perianth-leaves. The superior ovary may be compressed or three-sided, but is not winged, and the entomophilous character is reflected in the simple *capitate* or knob-like stigmas which terminate the two or three stigmas. The brown and generally polished seeds contain a mealy albumen which forms the valuable portion of the nearly allied Buckwheat (*Fagopyrum esculentum* Mœnch), the *Blé Sarrasin* of the French, so-called because introduced either by the Crusaders or by the Moors in Spain.

The Amphibious Persicaria (*P. amphibium* Linné), a native of North Temperate and Arctic regions, is a striking plant and exhibits a two-fold dimorphism, both in

vegetative characters and in flowers. It is a perennial and has a slender, creeping, woody, branched rhizome, with numerous whorls of white or red rootlets. When floating, the stems may be two or three feet long, and are supported by floating, ovate-lanceolate, acute leaves with petioles from one to three inches long; and the whole plant is glabrous. When the plant grows on land, as when the mud is thrown out of a pond or ditch on to its banks, the stems are not developed to the same length but are about a foot high and erect; the leaves are narrower and have stalks not more than an inch in length; the whole plant becomes hairy; and flowers are only sparingly produced. These floating and terrestrial forms, however, are not constant, one readily becoming transformed into the other if transplanted.

The rose-coloured flowers are borne above the surface of the water in handsome ovate or oblong spikes of densely-packed blossoms on stout stalks. The stamens in this species are only five in number, alternating with the perianth-segments, or they may be altogether absent, such flowers being entirely female. There are two styles, united for half their length and terminated by globular rose-red stigmas; and the relative length of the filaments and styles varies on different individuals, some having long *exserted* stamens and short styles and others short stamens and long styles. In all probability this dimorphism, or *heterogony*, like the precisely similar arrangement in the Primrose, is accompanied by a *prepotency* of the pollen of the long stamens on the stigmas of the long styles, and so also of the short forms, thus favouring reciprocal cross-pollination. Nectar is secreted by five orange-yellow glands upon the floral receptacle around the base of the ovary, alternating with the stamens, so that this species in its conspicuous floral colouring, in the individual variation of mechanical contrivance or proportions, and in this inducement held out to its insect-visitors, proclaims itself a highly specialised type of entomophilous flower.

The mealy seeds are said to be favourite food for water-fowl; but they are seldom ripened. This striking plant has not attracted the attention that is manifested by many popular names. Some, such as *Flatter Dock*, *Red Shank*, and *Lakeweed*, it shares with other species. Among those more particularly belonging to it are *Ground Willow*, *Willow-grass*, and *Willow-weed*.

LVII.—THE MARSH SAMPHIRE.

Salicornia herbacea Linné.

FEW of the *Polygonaceæ*, even when their perianth does consist of two whorls of leaves, show much differentiation towards the calyx and corolla of higher types. The coloured, nectariferous, and dimorphic flowers of some species of *Polygonum* do, however, suggest the beginnings of more specialised forms ; and, when its characters are set down in the necessarily general terms true of most of its varied Families, there is but little to show Engler's tenth Order, the *Centrospermæ*, to be higher than *Polygonales*. This Order consists mainly of herbaceous plants, the flowers of which may present the more primitive acyclic arrangement or be whorled ; and have sometimes a perianth with no distinction between its whorls ; and at others a distinct calyx and corolla. Their stamens vary from one to an indefinite number ; but their frequent position in front of the perianth-leaves suggests that there are degraded types included. The carpels also vary in number ; but they are mostly syncarpous, and the most general characters of the Order are the one-chambered ovary with central placentation and the embryo curved round the perisperm. One can hardly hesitate in considering the *Chenopodiaceæ* as the lowest of the Families included in this Order and the *Caryophyllaceæ* as the highest.

The *Chenopodiaceæ* are not a large Family, only comprising some 500 species in about seventy-five genera ; but they are widely distributed over the shores, deserts, and steppes of the world, many species also occurring as weeds in cultivated land. This distribution is the result of their exceptional power of absorbing alkaline salts, especially, it would seem, nitrates of potash and soda. The cooling taste of the leaves of the various species cultivated as spinach, and the former use of others, such as *Salsola* and *Salicornia*, in the preparation of barilla for the manufacture of glass, both result from this function. When plants are surrounded by large quantities of salts in the soil and have this power of absorbing them, it is necessary, in order to avoid concentration, that transpiration should be reduced ; and many *Chenopodiaceæ* accordingly have fleshy leaves, or are covered with hairs or with a mealy excretion. Whether inhabiting dry deserts or saltings, where they are covered at every high tide by the waters of the ocean, they are alike structurally and physiologically xerophytes. They have generally branched tap-roots ; scattered, simple, exstipulate leaves ; and small, inconspicuous flowers with a persistent perianth of one whorl only, of sepaloid leaves, five or less in number, and as many or fewer stamens, opposite the leaves of the perianth. The ovary is superior, one-chambered, and one-ovuled, and forms a dry achene in the fruit stage, the solitary ovule rising from the base of the ovarian cavity. When both stamens and carpels occur in one of these small flowers it is probably self-pollinating : in other cases the pollen may be carried by crawling insects or by the wind ; but the flowers have in general neither honey nor other special adaptation for any method of cross-pollination.

THE MARSH SAMPHIRE—continued.

In many plant-associations the absence of extreme conditions is reflected in the general aspect of the vegetation. Plants enjoying moderate warmth and moisture at one season, while active growth is checked by cold at another, may be crowded together in considerable variety ; but will seldom have amongst them either the translucent ribbon-like leaf of the submerged aquatic, or the fleshy stems or foliage of the xerophyte. With extreme conditions, whether of moisture or of drought, vegetation becomes in general less varied : the plants grow more in open order ; and each of them, no matter what its affinities may be, will exhibit the marked adaptations fitting it to its abnormal surroundings.

Nowhere is this more strikingly exemplified than in our saltings. Here on wide level stretches of mud in estuaries or protected bays, which are only left bare at low water of spring-tides, are rooted masses of Grass-wrack (*Zostera marina* Linné) and nothing else. A little farther inland, where the mud is uncovered at neap-tides, are scattered plants of *Salicornia herbacea* Linné ; or, on Southampton Water and other southern shores, the Cord-grasses (*Spartina*). Farther inshore, *Salicornia* grows in closer colonies, though never crowded : patches of *Alsine marina* Wahlenberg occur, especially if there is an admixture of sand, and Sea Arrow-grass (*Triglochin maritimum* Linné) ; while the banks of the creeks which are cut through the mud are covered with Sea Purslane, or Crab-weed, as it is sometimes called, another Chenopodiad (*Obione portulacoides* Moquin), or with the Starwort (*Aster Tripolium* Linné). Most of these plants, representing several different Orders, show the fleshiness that indicates water-storage tissue within, the direct result of the scarcity of fresh water and the concomitant of diminished transpiration.

From its growth in the mire *Salicornia* is sometimes known as Frog-grass ; while the name Sea-grape is an apt comparison of the fleshy translucent joints of its stem to unripe grapes ; and its Latin name, from *sal*, salt, and *cornu*, a horn, and the popular names Saltwort and Glasswort refer to the large amount of sodium salts in the ash, on account of which it is still employed in glass-making in the Mediterranean. The name Marsh Samphire is merely borrowed from the true Samphire (*Crithmum maritimum* Linné), a dweller on the rocks. On the coast of Lincolnshire *Salicornia* is still pickled under the name of Samphire, and is preferred to *Crithmum*.

Until recently *Salicornia* has been described as leafless, the fleshy casing of its internodes (rising in two points as a socket round each node and filled with water-storing tissue, which often turns red in autumn) being looked upon as the cortex of the stem ; but several careful studies show that this is really a downward sheath-like extension of two united leaf-structures.

LVIII.—ANALYTICAL DRAWINGS OF THE NETTLE, SANDALWOOD, AND KNOT-GRASS ORDERS, AND OF THE GOOSEFOOT FAMILY.

(*Urticales*, *Santalales*, *Polygonales*, and *Chenopodiaceæ*.)

THE nine types of which analytical drawings are given on this Plate constitute a somewhat heterogeneous assemblage. What we now know as the Order *Urticales* was long ago recognised as including plants so doubtfully akin to one another that it was styled "the botanist's marine-store shop." The Order *Santalales* consists mainly of parasitic plants presenting many remarkably exceptional and apparently primitive characters. The Order *Polygonales* is certainly akin to the Family *Chenopodiaceæ*, which is included by Engler in the Order *Centrospermæ*.

The first four types that occur here—the Wych-Elm, Hop, Nettle, and Pellitory—belong to the Order *Urticales*. They mostly agree in having a whorled polysymmetric calyx, or herbaceous perianth, with stamens superposed to its leaves, and an ovary containing a single ovule and forming a small nut-like fruit.

Of the three component Families of the Order, the Wych-Elm represents the *Ulmaceæ*, the Hop the *Moraceæ*, and the Nettle and the Pellitory the *Urticaceæ*.

The *Ulmaceæ* are trees with simple, stipulate, and often oblique leaves, usually perfect flowers with a perianth and two united carpels forming a two-chambered ovary, one chamber of which, however, becomes aborted. In the Elms the number of perianth-leaves in each of the little flowers in the reddish tufts that appear before the leaves may be four or five, the stamens being of the same number. The fruit is a *samara* or winged nut, the wing being in reality double, one-half belonging to each carpel and each half terminating above in an incurved apex.

The first figure in the first line is a flower of the Wych-Elm, natural size; Fig. 2 is one enlarged, with a bract below it; Fig. 3, the same in section; Fig. 4, an anther; Fig. 5, the characteristic apex of the samara, enlarged, showing the points of the two wings and the "sinus" between them, together with a whole samara of natural size, showing the central position of the seed-cavity; Fig. 6 is a seed, and Fig. 7 shows one in longitudinal section.

The Family *Moraceæ* includes such diverse types as the Mulberries, Figs, Breadfruits, Hemp, and Hop, the last two more obviously related and often treated as a distinct Family. Most members of the Family are trees with a milky latex, unisexual flowers, and a perianth of four leaves; but the Hemp and Hops are herbaceous plants with watery juice and no true perianth in the female flowers.

In the second row of figures, Fig. 1 is a staminate flower of the Hop; Fig. 2, the same enlarged; Fig. 3, a female flower with its bracteole; Fig. 4, two such flowers in the axil of one bract; Fig. 5, a complete "strobilus" or fruiting catkin; Fig. 6, a single fruit with its adherent wing-like bract; Fig. 7, a fruit, showing its orange glands of lupulin; and Fig. 8, the same in section.

ANALYTICAL DRAWINGS OF THE NETTLE, SANDALWOOD, AND KNOT-GRASS ORDERS, AND OF THE GOOSEFOOT FAMILY—continued.

The *Urticaceæ* are mostly herbaceous, with watery juice; polysymmetric unisexual flowers; explosive anthers and single erect ovules. The Small Nettle (*Urtica urens* Linné), represented by the third row of figures, is monœcious, Fig. 1 showing an inflorescence; Fig. 2, a staminate flower magnified; Fig. 3, a female flower; Fig. 4, a fruit; and Fig. 5, the same seen in section. The Pellitory (*Parietaria ramiflora* Mœnch) is polygamous, Fig. 1 in the fourth line representing a staminate flower; Fig. 2, the same enlarged; Fig. 3, a female flower; Fig. 4, one of the explosive stamens; Fig. 5, the gynæceum magnified; Fig. 6, young male and female (protogynous) flowers; Fig. 7, a similar group in the later or male stage; Fig. 8, a fruit, and Fig. 9, the same in section.

The fifth row of figures represents the very anomalous Mistletoe (*Viscum album* Linné), our only British member of the Family *Loranthaceæ*. Fig. 1 is a male inflorescence, the species being diœcious; Fig. 2, the same enlarged; Fig. 3, a female flower enlarged; Fig. 4, a seed with two embryos; Fig. 5, a berry, and Fig. 6, the same in section.

The Bastard Toad-flax (*Thesium humifusum* De Candolle), our only representative of the *Santalaceæ*, is represented by the sixth line of figures. Fig. 1 is an inflorescence; Fig. 2, one of the perfect flowers; Fig. 3, the same enlarged; Fig. 4, the corolla, stamens, and gynæceum dissected and enlarged; Fig. 5, one of the incurved petals and a stamen; Fig. 6, a fruit; and Fig. 7, the same in longitudinal section.

The seventh and eighth lines of figures represent *Rumex* and *Polygonum*, the two chief genera in the Order *Polygonales*, the former mainly taken from the diœcious Sheep's Sorrel (*Rumex Acetosella* Linné). The first figure in the seventh line is the side view of a flower; Fig. 2, the same seen from above; Fig. 3, a side view of a staminate flower slightly enlarged; Fig. 4, a similar view of a female flower; Fig. 5, an enlarged view of one of the perfect flowers of the Common Dock (*Rumex crispus* Linné); Fig. 6 is a winged fruit magnified; Fig. 7, the same without the wings; and Fig. 8, in section.

In line eight, Fig. 1 is a flower of *Polygonum amphibium* Linné; Fig. 2 is the same so opened as to show the stamens on the corolla; Fig. 3 is the gynæceum with two styles; Fig. 4, a stamen; Fig. 5, a young fruit with the perianth; Fig. 6, a section of a fruit, and Fig. 7, a spray of young fruits.

The last line of figures represents the remarkable halophyte *Salicornia herbacea* Linné, Fig. 1 being a shoot showing the flowers; Fig. 2, part of the same enlarged, and Fig. 3, a flower consisting of a solitary stamen and the gynæceum.

LIX.—PERFOLIATE SPRING-BEAUTY.

Claytonia perfoliata Donn.

THE small Family *Portulacaceæ* is cosmopolitan, but mainly American. Of the two or three species that represent it in this country, one—the inconspicuous, self-pollinating little Water Blinks (*Montia fontana* Linné)—is also cosmopolitan ; but the species of *Claytonia* have but little claim to be considered as indigenous British plants.

Most members of the Family are smooth, succulent, annual herbs, with simple, entire leaves and cymes of perfect, and often showy, blossoms. There are two sepals or bracteoles, united at the base ; usually five petals ; five or ten stamens ; from two to eight, but generally three, carpels united into a one-chambered ovary ; and a few ovules bent on themselves like horseshoes (*campylotropous*) and springing from a basal placentation. The flowers are generally nectariferous and insect-pollinated, and the capsular fruits are often explosive.

The genus *Claytonia* is distinguished by its five stamens and free petals. It comprises some twenty species, natives of North Temperate and Arctic Zones in America and North-west Asia, but found also in Australia. Some of them are perennial ; but the two species which have become naturalised in Great Britain are both generally annuals. Flowering early by the sides of streams in Virginia, they have obtained in their native country the name *Spring-Beauty ;* but cannot be said to be as yet generally known here by that or any other name.

The genus was discovered by the botanist whose name it bears. John Clayton was born in Fulham, probably in 1686, and went to Virginia in 1705 with his father, an eminent lawyer who became attorney-general of the colony. He entered the office of the Clerk or Protonotary of Gloster County, and, succeeding to the post, held it for more than fifty years. He died in 1773. His manuscripts and herbarium were destroyed in the War of Independence ; but the specimens which he sent to Gronovius and which formed the basis of the latter's "Flora Virginica" (1739-45) are preserved in the British Museum collection at Cromwell Road, having been first bought by Lord Bute in 1778 for £90 or £100 and then in 1794 by Sir Joseph Banks for less than half as much.

Claytonia perfoliata was not known in England much before the beginning of the nineteenth century, and was not at all generally recorded in a wild state before the middle of the century. It has, however, increased very rapidly, and is now very general on sandy soil even at a distance from cultivation, whilst it sometimes becomes a troublesome weed in gardens. The larger lilac-flowered *C. sibirica* Linné is less common.

It is very difficult to determine the precise period at which, and the means by which, the various components of our existing flora reached Britain. Unquestionably, many plants now well established and apparently wild are not truly *indigenous* in the

sense of having been here before the arrival of man. Besides the intentionally-introduced species which we cultivate, whether for food, timber, fibre, medicine, or other purposes, several grades have been recognised among *aliens*, or species unintentionally introduced, according to their degree of establishment. Temporary introductions, such as many brought in ships' ballast, or in foreign wool, or escaping from gardens, but unable to hold their own, are known as *casuals*. Weeds of cultivated ground, which may be of ancient introduction but do not pass beyond the limits of cultivation, such as our Poppies, are termed *colonists*. On the other hand, escapes from cultivation, which, like *Claytonia perfoliata*, are able to reproduce themselves freely and to spread away from cultivation, are known as *denizens*.

Claytonia perfoliata grows to a height of from four to twelve inches and has a few fleshy rhomboid radical leaves; while its pairs of cauline leaves—one on each stem pair—are united into a sub-orbicular and equally fleshy blade with two slight points. The slender inflorescence rising from the centre is a somewhat complex sympodial cyme, though appearing like a racemose series of three-flowered whorls. Before the small flowers have been pollinated they stand erect. Within the two sepals or bracteoles, the five white petals, slightly notched at their tips, rise a little higher than the sepals and honey is secreted at the base of each, so as to be accessible to any short-tongued insects. The five stamens are opposite to and attached to the bases of the petals, and their anthers mature before the stigmas do so. After the anther has split and discharged its pollen the filament moves outwards, *i.e.* farther from the centre of the blossom. The superior ovary is surmounted by a three-cleft style, and after the pollination of the stigmas the flower-stalk bends downwards through about 180°, bending back once more into the vertical position when the seeds are ripened. The globular membranous capsules split, when ripe, into three valves, and these as they dry contract so as to throw the three comparatively large, black seeds to some little distance. This scattering of the seed is facilitated by their position, each lying across the line along which the valves separate, and this mechanism is probably the main explanation of the rapidity with which this alien species has spread over the country.

The addition to our flora from time to time of such attractive aliens is some compensation for the loss of British species which, from various causes, are exterminated.

LX.—SEA-SIDE SANDWORT-SPURREY.

Alsine marina Wahlenberg.

THE extensive and well-defined Family *Caryophyllaceæ*, which may be termed the Pink Family, although cosmopolitan, is mainly represented in Arctic latitudes, alpine altitudes, or in Europe and Western Asia. No members of the Family are put to much use ; but many of them with showy blossoms, mostly red or white, are favourite garden flowers, such as the Carnations, Sweet Williams, and Campions. They are mostly herbaceous, although occasionally their stems become woody below ; and swollen joints or nodes are as characteristic as in *Polygonaceæ*. The leaves are in opposite pairs, simple, and usually entire, and stipules may or may not be present. The branching is strikingly cymose, the main axis ending in the first flower, and one or two lateral branches springing from the axils of the pair of leaves below it and ending in their turn in flowers, and so on. The flowers are generally polysymmetric, complete, perfect, and pentamerous, with five free or united sepals, five petals, often notched or bifid, ten stamens and from two to five carpels united into a superior one-chambered ovary, with more or less separate styles and numerous ovules on a free central placenta. The ovules are usually campylotropous ; and the fruit is a capsule opening by valves or by teeth at its apex, the number of these being either equal to or double that of the styles. As the ripe fruits generally stand erect, only a few seeds at a time are shaken out of them as their dead stalks sway in the wind. This "censer-action," as it is called, is a great economy of seed.

Most, if not all, of the species secrete honey at the base of their stamens : most of them are protandrous, and are adapted to insect-pollination ; but in many small-flowered forms homogamy and self-pollination occur.

The Family is divisible, both morphologically and biologically, into two Sub-Families, one obviously a lower type of organisation than the other, the *Alsinoideæ* and the *Silenoideæ*. In the former the sepals are free : in the latter they are united in a calyx-tube ; as a result of which structural character the honey is in the former accessible to short-tongued insects ; but in the latter only to the long-tongued bees and Lepidoptera.

The *Alsinoideæ* have mostly white, small flowers and ten stamens ; but the inner whorl may be missing, or some flowers may be entirely carpellate, those on other individuals being perfect, a condition known as *gynodiœcism*. Whilst most *Caryophyllaceæ* have sessile leaves with bases broad enough to protect the young axillary buds and have, therefore, no stipules, the *Alsinoideæ* fall into two sections or Tribes, the *Sperguleæ* and the *Alsineæ*, of which the former has narrow leaves and membranous stipules.

In dealing with the *Alsinoideæ* there has been a considerable confusion of names,

more indeed than of the plants themselves, with the result that those to which we now apply the name *Alsine* do not belong to the *Alsineæ* but to the *Sperguleæ*.

The name *Alsine*, used by Dioscorides, is stated by Pliny to be derived from ἄλσος, *alsos*, a grove, and, if so, would have been more appropriately applied to the genus *Stellaria*. The Tribe *Sperguleæ* comprises plants long known as Spurrey, though now referred to the two genera *Spergula* and *Alsine*. The name *Spurrie* is said by Cotgrave to be French, and Lyte suggests that it is the origin of the scientific *Spergula*, though this has often been derived from *spargo*, I scatter, with supposed reference to the free scattering of the seed. Dr. Prior, however, connects these names, and the French *Espargoutte* and German *Spark*, with a Low Latin *Asparagula* and the Greek σπαράσσω, *sparasso*, I rend, or ἀσπαίρω, *aspairo*, I am convulsed.

The genus *Spergula* has small stipules, five styles, and five valves to its capsules. It comprises a small number of species, which are weeds in cultivated land. The genus *Alsine* Linné has been very generally known as *Spergularia* Persoon. It is cosmopolitan, comprising some twenty species, most of which are halophytes, having relatively large membranous, connate, persistent stipules, somewhat fleshy stems and leaves, and only three styles and three valves to their capsules, and inhabiting the sea-shore or dry sandy places. Sir Joseph Hooker writes of the species as "very variable," and says that they "may be regarded as sub-species of one"; but there seem to be at least four fairly distinct and constant British forms, characteristic of differing habitats.

A. marina Wahlenberg, otherwise known as *Spergularia marginata* Kittel, is a perennial form with a woody rhizome; compressed reddish aerial stems; broadly triangular, usually entire stipules; semi-cylindric, sub-acute leaves; long flower-stalks; petals pale pink, with a white base; ten stamens; very large capsules, longer than the calyx; and compressed, rounded reddish seeds with a thick margin extended into a broad membranous wing.

It is especially characteristic of muddy shores, such as those of estuaries. Here (where the tide at high water submerges the saltings with Grass-wrack and Marsh Samphire) on firmer ground, beyond the reach of most tides, we find this species, with Arrow-grass, Sea Plantain, Sea Lavenders, Sea Milkwort, Scurvy-grass, etc., succeeded farther inland, on higher and drier ground, by Thrift, Centaury, and Stone-crop.

LXI.—STITCHWORTS.

Stellaria Linné.

WHILST having distinct sepals, like the Tribe *Sperguleæ*, the *Alsineæ* have no stipules. Many of them have, as we have seen, small, white flowers, which may have entire petals, as in the Pearlworts, and may either have the valves of their capsules equal in number to their styles, or, as in *Stellaria*, twice as many.

The genus *Stellaria* comprises some eighty species, natives of Temperate and cold climates. Its name, which obviously refers to its star-like blossoms (from the Latin *stella*, a star), is traced back to Otto Brunfels. Brunfels was born near Mayence about 1464, and, after being a Carthusian monk, became a schoolmaster at Strasburg and eventually a physician at Berne, where he died in 1534. His "Herbarum vivæ eicones" was published at Strasburg in 1530–6, and, although the text consists mainly of literary discussions as to the plants intended by the names in earlier writers, this book is generally considered to mark the beginning of the Renaissance of botany, because many of the beautiful woodcuts it contains have obviously been drawn direct from Nature.

The six or seven British species have many points in common. They are mostly glabrous and so slender that the name Stitchwort has been misunderstood as referring to their thread-like stem. Their leaves are generally narrow and pointed, and their white flowers in loose cymes, secreting some honey, and protandrous. Although in some, as in the Common Chickweed (*Stellaria media* Villars), self-pollination commonly occurs, insect visits seem thus to be, in all cases, provided for. Although reduction in number and size of the floral leaves also occurs, five is the prevailing number, and the petals are bifid, sometimes so deeply as to be each mistaken for two. The stamens are perigynous, usually ten in number, in two whorls which mature in succession, the outer row rising and bursting their anthers before the inner ones, while the honey is secreted by five glands situated between the bases of the stamens. There are generally three styles, and the globose capsules split at the top into six valves.

With these points in common, however, there are various interesting distinctive peculiarities of the different species. The Chickweed is an annual, flowering almost all the year round and completing its life-history within the compass of a few weeks. In winter cleistogamous flowers are produced ; and at other seasons the stamens, which have violet anthers, are generally reduced in number to eight, six, three, or even two, and mature almost simultaneously with the stigmas. Failing insect visits, the flowers commonly pollinate themselves ; but experiments show the seeds from cross-fertilised flowers to be more vigorous than those from the self-fertilised. While the rest of the plant is glabrous, there is a line of comparatively long juicy hairs down one side of each internode of the stem and down both sides of the petioles of the lower leaves. The line of hairs on the stem shifts

its position from one side to the other at each node. These lines of hairs have been variously explained, either as serving to draw off the rain-water from each successive cup formed by the bases of the upper leaves, which are sessile, and thus keep the leaf-surface dry, or as absorbing the moisture by the basal portion of each hair.

All the four species represented in our Plate have four-angled stems. *Stellaria uliginosa* Murray, on the extreme left of the picture, inhabiting wet places, is a perennial varying considerably in size, slightly glaucous, with small lanceolate leaves callous at their tips and ciliate at the base, membranous bracts, and petals shorter than the sepals. The larger *S. graminea* Linné, which is figured next to it, is a straggling plant, growing in dry heathy places, with sessile, linear-lanceolate, acute leaves, ciliate at the base, and flowers from half an inch to three-quarters of an inch across, in which the deeply bilobed petals are as long as, or longer than, the three-veined sepals. After each row of stamens has moved upwards, burst its anthers, and bent outwards and downwards, the styles elongate and go through the same movements, so that, although, with honey unconcealed, the blossoms are visited alike by flies, beetles, bees, moths, and butterflies, if not cross-pollinated, they can be self-pollinated. The less common *S. palustris* Retzius, which occupies the centre of the Plate, is, as its name indicates, an inhabitant of marshy ground, is glaucous, and has no cilia on its leaves or bracts.

The most attractive member of the genus is *S. Holostea* Linné, which appears at the right of our Plate. Its stems do not, as do those of most herbaceous perennials, die down to the ground in winter, but though dead to all appearance, send out delicate green shoots in March, so that the plant appears to have made a very rapid growth, whilst its April blossoming has earned it the name of Cuckoo-flower. Nearly sixty popular names testify to the notice and esteem which this species obtained in former times. "Snap-stalks," "Tongue-grass," "Satin-flower," and "Lady's White Petticoat" refer only to its outward appearance ; but "Stitchwort," "Break-bones," "All Bone," and the scientific *Holostea* (from the Greek ὅλος, *holos*, whole ; ὀστέον, *osteon*, bone), which dates from Dioscorides, refer to its former imaginary uses, according to the doctrine of signatures. Gerard can only suggest as an explanation of this last name "the figure called Antonomia," *i.e.* a *lucus a non lucendo ;* and explains Stitchwort as referring to the use of an infusion of the plant against pain in the side. Still earlier, perhaps, it was supposed to cure the "stich" or sting of venomous reptiles. *Holostea*, however, probably means that, as the nodes of the plant are swollen like the extremities of limb-bones and are markedly articulated, it was to be presumed useful to bring about the knitting or stitching of broken bones. Its pretty flowers, which contrast so charmingly with its grass-green foliage in our Spring hedgerows, are so markedly protandrous that they are probably exclusively entomophilous.

LXII.—THE CORN-COCKLE.

Lychnis Githago Scopoli.

THE second and higher Sub-Family of the *Caryophyllaceæ*, the *Silenoideæ*, has exstipulate leaves, a gamosepalous calyx, and hypogynous stamens. The flowers are often large, and as frequently rose-coloured, or some other shade of red, as they are white. Though the petals are not united, the tube formed by the gamosepalous calyx is so filled up by the claws of the petals and by the stamens as to render the honey at its base inaccessible to any but long-tongued bees and Lepidoptera. The blossoms of some white-flowered species open, or remain open, at night, or give off their perfume only at night, and are pollinated by night-flying moths. Many large-flowered, tubular forms are alpine plants, and are pollinated by butterflies, the group of insects which reaches the greatest mountain altitudes.

The Sub-Family *Silenoideæ* is divided into two Tribes, the *Lychnideæ* and the *Dianthеæ*, distinguished essentially by characters in the calyx, the seed, and its embryo. The *Lychnideæ*, including the genera *Lychnis* and *Silene*, the Campions and Catchflies, have additional or *commissural* ribs or veins in their calyx in addition to those forming the midribs of the five sepals. The *hilum*, or scar at which the seed is attached to its stalk, is, in this group, on the edge of the flattened seed ; and the embryo, or young plant within the seed, is curled in a ring round the albumen. On the contrary, the *Dianthеæ*, or Pinks and Gypsophilas, have only five ribs to the calyx, the hilum on the face of their peltate seeds, and a straight embryo.

Within the limits of the Tribe *Lychnideæ* the genera are somewhat ill defined, the book character by which *Lychnis* is distinguished from *Silene*, viz. the possession of four or five styles with four, five, eight, or ten teeth to the capsule, as against the three styles and six capsule-teeth of *Silene*, not being constant. The genus *Lychnis* comprises some forty species, natives of North Temperate regions, six of them being British ; but the Corn-cockle (*L. Githago* Scopoli) has, by many authorities, been made the type of a distinct genus, *Githago* of Bock, Adanson, and Desfontaines, or *Agrostemma* of Linné. In the other species, as also in *Silene*, each petal bears, at the junction of its vertical "claw" with its horizontally spreading "limb," a little scale-like outgrowth known as the "ligule," which may or may not be divided into two lobes : in the Corn-cockle there is no such ligule.

The general characters of the genus *Lychnis* are that they are annual, biennial, or perennial herbaceous plants, sometimes viscid with glandular hairs, with no bracts immediately below the flower, with a five-toothed, ten-veined calyx, five long-clawed petals, ten stamens, and five carpels. These last are united into a superior ovary which, though one-chambered above, is divided below into five. It is surmounted by five styles and forms a capsule splitting at the summit, when ripe, into ten teeth. The carpels may be four in number, or even three, in which last case the distinction from *Silene* disappears.

The name *Lychnis* is employed by Theophrastus and is, no doubt, derived from the Greek λύχνος, *luchnos*, a lamp ; but its significance is doubtful. It has been suggested that the thick cottony substance on the leaves of some species, or some similar plant, was employed as wicks for lamps ; but, as some species have brilliant orange flowers, the name may only refer to their flame-like colour. The etymology of *Githago* is even more doubtful. It is employed by Jerome Bock, who published a herbal in 1532, styling himself Hieronymus Tragus ; and he, no doubt, meant that it resembled the plant spoken of by Pliny as *Gith ;* but it is difficult to determine what this was. There is no doubt, however, as to Linné's *Agrostemma*, which is from the Greek ἀγροῦ, *agrou*, of a field, στέμμα, *stemma*, a crown, a deserved tribute to this beautiful flower.

Like many other cornfield weeds, it is an annual ; but its tall, slightly branched stem, two to three feet high, bears up to the top of the corn its large terminal flower. Few soils can apparently be too dry and no situation too sunny for this largest and loveliest of our British Campions. Both its stem and its relatively insignificant linear leaves are densely covered with white hairs, a character suggesting its supposed origin in the dry regions of Asia Minor. The five long, pointed, leafy lobes projecting from the leathery calyx between the rounded apices of the petals are one of the distinctive characters of the proposed genus, whilst the length of the ovoid calyx-tube, which is from one to one and a half inches, restricts its honey to long-tongued Lepidoptera. The deep rose-colour of the petals fades towards the centre of the flower into their long white claws. It is suffused with a wonderful bluish bloom and traversed by finely-ruled dark lines as honey-guides. The included stamens generally mature before the stigmas, though this character is said to vary locally, and occasionally smaller flowers without stamens are found. The large ovoid capsule bursts by five teeth, shaking out the large black seeds, wedge-shaped segments of a sphere with rows of projecting points. These were formerly abundant in seed corn ; but modern high farming means purer seed and cleaner land, so that this, and many another pretty weed, is far less commonly seen in our cornfields.

Unknown apparently to the ancient Greeks, Romans, Britons, or Germans, it has been suggested that the Russian name *Kukael*, the Polish *Kakol*, and the *Kokkol* of the Anglo-Saxon Gospels, where the Authorised Version has "tares," may point to our early trade with Russia in the days of Alfred. Some of our cornfield weeds may go back to the days when Imperial Rome filled her granaries from distant provinces ; or even to the great waves of human migration in the Ages of Bronze and Stone ; and it is suggested that this Corn-cockle is an unintentionally cultivated form of a species (*Agrostemma gracilis* Boissier) native to Anatolia.

LXIII.—THE RAGGED ROBIN.

Lychnis Flos-cuculi Linné.

AS we have seen already, the genus *Lychnis* strictly so-called consists of perennial herbaceous plants with a ligule at the base of the blade of the petal, and generally five styles. The calyx may or may not be inflated, the capsule may or may not have partial partitions rising from its base, and there is considerable variety within the limits of the genus in the mode in which the fruit splits when ripe. The flowers are generally large and conspicuous and sometimes perfumed ; whilst the deep calyx-tube holding together the long claws of the petals renders the honey accessible only to long-tongued insects. The conspicuous character of the blossoms may be heightened in various ways. In the dead-white blossoms of the Evening Campion (*Lychnis alba* Miller), for instance, the petals touch so as to form an uninterrupted disk of white, very conspicuous at dusk, when the flower becomes sweet-scented and is visited by moths. In the Ragged Robin (*Lychnis Flos-cuculi* Linné), on the other hand, a similar effect seems to be produced with great economy of material by the wide-spreading petals being each cut into four narrow segments. While thus attracting the larger flying insects, it is desirable that the plant should be able to protect its nectar from the depredations of smaller crawling insects that may be no service to it in pollination ; and this would seem to be the explanation of the viscid character of the stem in the Ragged Robin and other species both of *Lychnis* and *Silene*, and of the downiness of others, such as the Red and White Campions (*Lychnis dioica* Linné and *L. alba* Miller). These hairs, whether glandular and viscid or not, serve to check climbing ants and other depredators ; but, in spite of the name Catchfly thus earned for various species of the two allied genera, there seems no reason to believe that these plants derive any nutriment from the bodies of their captives as do the Sundews and Pitcher-plants.

From a rhizome but slightly thickened the Ragged Robin sends up slender, repeatedly forking, angular aerial stems from one to two feet high, slightly downy below with short stiff, deflexed hairs and viscid higher up, and tinged with a dark reddish colouring-matter. The root-leaves are stalked and broadly lanceolate ; but the cauline ones are narrowly linear-acuminate. The flowers open in the typically *dichasial* cyme, the terminal one first, followed by two which terminate branches springing from the leaf-axils on either side of the first flower, and so on. The branches of the inflorescence diverge widely, so that six or eight blossoms may be expanded simultaneously on one stem. The individual flowers have short slender pedicels, which are generally so bent as to place the limb of the corolla in a vertical plane.

The calyx is tubular rather than inflated, and has ten dark-coloured ribs and five tapering teeth ; and the ligules of the petals are bifid. Honey is secreted by the bases of the filaments of the markedly protandrous stamens, and the anthers of

the outer whorl mature before those of the inner. The capsule is broadly ovoid and dehisces by five short teeth, and it has no traces of any internal partitions.

The most striking feature of the species, however, is, of course, the *laciniate* petals, deeply divided as they are into four strap-shaped segments. The Family *Caryophyllaceæ* is certainly exceptional in this respect. The petals, so generally rounded in other groups, or slightly *emarginate* or notched, as in the Roses, or inflexed at their apices, as in *Umbelliferæ*, are in this Family commonly either fringed with teeth, as in many Pinks, or more or less deeply bi-lobed, as in the Stitchworts. Even this manifold and deeply-cut division that we have in the Ragged Robin occurs also in several exotic species of *Dianthus*, such as *D. arenarius* and *D. superbus*. It is undoubtedly a conspicuous, though uncommon, character ; and, on wet, low-lying clay lands, fens, marshes, or the spongy, rush-grown margins of streams, no plant is more readily seen than the Ragged Robin.

This conspicuousness has earned for it a variety of popular names, such as Meadow Pink, Marsh Gilliflower, Wild Williams, and Cock's-comb ; but it is to its season of flowering, when the cuckoo is in full song, that it owes its scientific specific name and various English equivalents for it, such as Cuckoo-flower and Cuckoo Gilliflower. *Flos-cuculi* itself dates from the "History of Plants" of Hieronymus Tragus, alias Jerome Bock. About the eleventh of June, once the summer Solstice, when the hay is ready to cut, as the rhyme has it :—

"When St. Barnaby bright smiles night and day,
Poor ragged Robin blooms in the hay."

A white-flowered variety occasionally occurs, and one with double flowers is known in gardens, where it has borne the names Bachelor's-buttons, Fair Maid of France, and Pleasant-in-sight.

The two other common British species of the genus are *L. dioica* Linné, the Red Campion, with sub-diœcious, pungently-scented red blossoms, opening by day and pollinated by bees ; and *L. alba* Miller, with white blossoms, fragrant from about six o'clock in the evening to nine next morning, having a slightly longer tube to its flower and pollinated by moths. The former is mainly characteristic of moist copses, especially on loam or sand, whilst the latter seems to prefer a calcareous soil and such open sunny situations as cornfields. The Red Campion has short triangular calyx-teeth and a globular capsule with ten recurved teeth, while the White or Evening Campion has long narrow calyx-teeth and a conical capsule with straight teeth ; but a white-flowered variety of the red species and pink or red-flowered varieties of the white one occur, and apparently also hybrids between the two.

LXIV.—THE SEA CAMPION.

Silene amœna Hudson.

THE genus *Silene* is, as we have seen, so closely related to *Lychnis* that they cannot be separated by any constant characters. *Silene*, a name dating from Theophrastus in the fourth century B.C., is said to be derived from the Greek σίαλον, *sialon*, saliva ; but has been variously explained as referring to the viscid hairs on some species, from which they get the name Catchfly, or to the so-called "Frog's-spit" or "Cuckoo's-spit" common on others. This latter frothy slime is, it need hardly be said, the work neither of frog nor of cuckoo, but of a small insect parasite known as the frog-hopper. It is, no doubt, the frequent presence on its shoots of this substance that has given to the Bladder Campion (*Silene latifolia* Britten and Rendle) the names Frothy Poppy or Spatling Poppy, from the Early English *spatlian*, to froth.

The genus *Silene* is a large one, comprising several hundred species, mostly natives of Northern Temperate regions. Nearly 140 are European, the Mediterranean area being peculiarly rich in species. They are herbaceous and either annual or perennial, among the latter being several of the stunted, large-flowered "cushion-plants" characteristic of alpine situations, such as the *chomophyte* or screes-plant *Silene acaulis* Linné, the Moss Campion of our British mountains. There are no bracts immediately below the flowers, as there are in *Dianthus ;* and the five-toothed, ten-ribbed calyx is more or less *inflated*, *i.e.* there is a space between the calyx-tube and the enclosed claws of the petals. Although this type of calyx may be occasionally pierced by some bee endeavouring to make a short cut to the flower's store of honey, it appears that the main purpose of this inflation is to protect the honey from such ravages. The desirable insect-visitors that will effect cross-pollination, considering the long tube to the flower, are butterflies, moths, and long-tongued humble-bees, butterflies being the chief agents in the process for the alpine species and night-flying moths for those with white flowers. Although bees may bore through the calyx-tube, and may have a proboscis longer than the width of the space between calyx and petals, they will, in most cases at least, be unable to bore, across such an intervening space, through any such second thickness of tissue as the claws of the petals present.

The five petals each have a long narrow claw and usually a ligule of two scales, while the blade may be either entire or divided. Of the ten stamens, the five forming the outer whorl are sometimes adherent to the short *gynophore* or elongation of the floral axis below the ovary, whilst the five of the inner row adhere to the claws of the petals. There are usually three, but occasionally four or five, carpels united into an ovary which has partition-walls across its lower half, with distinct styles and numerous ovules. The shortly-stalked capsule is usually six-toothed : the flattened seeds have a marginal hilum ; and the embryo is curved.

THE SEA CAMPION—continued.

Of our nine British species, two—the Bladder Campion (*Silene latifolia* Britten and Rendle) and the Sea Campion (*S. amœna* Hudson)—are so closely related that in all probability most of the physiological observations made in the case of the one will prove to be equally true in the case of the other. Were it not so common as to be treated with the contempt born of familiarity, our inland Bladder Campion would be recognised as, in several respects, a remarkable plant. The whole plant is fleshy and generally smooth, both stems and leaves being covered with that grey waxy bloom which is so much more frequent on sea-side plants. This bloom prevents rain-water from wetting the surface ; but the rain accumulates at the bases of the leaves and may be absorbed by them. An uncommon variety known as *puberula*, with short curly hairs, occurs in dry places and is represented in the south of Europe by a densely hairy form. The erect stem, branching unequally and bearing membranous bracts, terminates in numerous drooping flowers. The much inflated calyx is globular, narrowing at its mouth, and is distinctly lined with a network of purplish veins. The deeply-cloven white petals, sweet-scented at night, recall its allies the Stitchworts, while the ligules are hardly visible. Three forms of flower—perfect, staminate, and carpellate—occur, the perfect and staminate ones on one plant, perfect and carpellate ones on another.

The Sea Campion is a more attractive plant. Deeply rooted by its tap-root in shingle, it spreads out leafy stems in a cushion from which rise the short and but little branched flowering stems. The bracts are leafy, and the almost solitary terminal flowers are larger than those of the Bladder Campion. The calyx is more inflated in its upper half and does not narrow at its mouth, and the petals are only shortly cleft and have distinct ligular scales. The violet-blue anthers are conspicuous in contrast with the dead-white of the petals.

The extensive mats of this plant, with the darker green of the Sea Purslane (*Arenaria peploïdes* Linné), among which rise many plants of a form of Dock (*Rumex crispus* Linné), along with dense low thickets of Sea Blite (*Suæda fruticosa* Forskäl), form the characteristic shingle-beach community of Blakeney Point, Norfolk, which has now fortunately been secured as a "Nature reserve." Its fleshy glaucous foliage and matted growth are distinctively *halophytic*, *i.e.* maritime, adaptations ; and the occurrence of some at least of these characters in its inland ally makes us speculate, as in the cases of many other sun-loving xerophytes among the *Caryophyllaceæ*, as to whether their ancestry was not maritime.

It is remarkable that the pretty Sea Campion has not received a tithe of the popular appellations of its inland congener ; in fact, the name Thimble, or Witches' Thimble, in the North is almost its only truly popular name.

LXV.—THE CHEDDAR PINK.

Dianthus glaucus Hudson.

AT the summit of the *Caryophyllaceæ* in organisation and in beauty is the genus *Dianthus*.

The Tribe *Dianthæ*, which comprises this genus and *Gypsophila*, is characterised by the absence of commissural veins in the gamosepalous calyx ; by the attachment of their round and flattened, or *peltate*, seeds by a central funicle ; and by the straightness of the embryo. The genus *Dianthus* itself is variously estimated as having seventy or two hundred and thirty species, mostly tufted, wiry, perennial, alpine, or rupestral herbs, with grass-like, and often glaucous, leaves ; conspicuous pink flowers, with two or more imbricate, opposite bracts immediately below the tubular calyx, long-clawed petals, very protandrous stamens, and two styles ; and a four-toothed, many-seeded capsule.

As the leathery glaucous leaves, with but few stomata equally dispersed over their two similar ascending surfaces, suggest, they are essentially xerophilous plants, inhabiting sunny situations in North-west America, South Africa, and, more especially, the Mediterranean area of the Old World ; while their tufted habit and large or conspicuous, protandrous flowers point to alpine stations and pollination by butterflies. In a truly wild state most of the species are rupestral, insinuating their roots into the slightest crevices of the bare rock, or spreading themselves out in the sun amongst the loose stones of the moraine of the departed glacier. In the haunts of man they have often betaken themselves to the ledges of the stonework of castle or abbey ; and their many minute seeds, shaken economically a few at a time from the open top of the capsule, have spread them afar. In this way several species that have no real claim to be considered indigenous to Britain have established themselves. Among these are *Dianthus plumarius* Linné, the parent type of our garden Pinks, and *D. Caryophyllus* Linné, the Clove Pink or Carnation. As wild tracts of land are constantly being conquered by the plough, almost every species of the genus, four of which are truly indigenous, is becoming rarer than it was. The deep rose stars of the Deptford Pink (*D. Armeria* Linné), dotted with white, are less frequent in hedgerows and thickets ; and the larger blossoms of such solitary-flowered species as the Maiden Pink (*D. deltoides* Linné) unfortunately tempt their transfer from their hilly home pastures to the garden.

Restricted as is its present distribution in our island, there is no reason to doubt the indigenous character of the Cheddar Pink (*D. glaucus* Hudson). Its continental distributional area accords well with its being truly wild in southern England. From Lombardy, Hungary, Switzerland, and Southern France, where from the limestone hills of Grenoble it got the name *D. gratianopolitanus* of Villars, it extends to the Belgian Ardennes. The plant recorded in Dillenius's edition of Ray's "Synopsis" (1724) as found by Du-Bois in the north of England was

probably the very glaucous variety *glauca* of *D. deltoides*, which has white petals with a violet ring round the centre of the blossom. The grand gorge in the Mendips, the sole habitat in England of the *D. glaucus* of Hudson, from which it takes its name of *Cheddar Pink*, does not seem to have been botanically explored until Samuel Brewer, a native of the neighbouring town of Trowbridge, who collected for Dillenius, found it there, as recorded in the "Synopsis." The locality is there printed as "Chidderroks."

There, where ivy-clad grey limestone rocks rise sheer with stepped summits like battlemented turrets, or stand out from the cliff-like walls as massive natural buttresses frowning dark over the narrow roadway, but bearing scattered bushes and lower growth aloft toward the sun, this choice rarity grows with the equally local Mountain Meadow-rue (*Thalictrum montanum* Wallroth) on many an inaccessible ledge. The cottagers of the neighbourhood collect it and offer it for sale to the tourist visitor; but fortunately it is readily and profitably increased by cultivation in their gardens, and is also protected from complete extermination by the absolute inaccessibility of some of the plants.

It is a tufted plant, with long, slender woody branches to its perennial root-stock; linear smooth leaves one and a half to two inches long, with a blue-grey bloom, a rough edge, and three prominent veins; and solitary flowers about an inch in diameter. These delicate pale rose-coloured blossoms are delightfully fragrant. They have four roundish, pointed bracts at the base of the reddish calyx, and the petals are irregularly toothed at their broad ends. Some specimens produce flowers exclusively female.

It is admirably adapted for an edging to a flower-border or for massing on a rockery. It likes a well-drained warm soil with humus and some shelter; and, as it ripens its seed freely, it can be propagated by seed. It is, however, much easier to multiply the plants by dividing them during mild weather in early autumn or in spring; or they can also be increased by layering.

The species is often known by the name *D. cæsius* Smith, from its bluish foliage; but Hudson's name is the earlier.

LXVI.—ANALYTICAL DRAWINGS OF THE PURSLANE AND PINK FAMILIES.

(*Portulacaceæ* and *Caryophyllaceæ*.)

THE Family *Chenopodiaceæ*, here represented by *Salicornia herbacea* Linné, though it has some slight affinity with the *Polygonaceæ*, is more closely related to the *Portulacaceæ* and *Caryophyllaceæ*. It is now classed with these Families, and other exotic groups, in the Order *Centrospermæ*, named, as we have seen, from the character that the ovules, whether one or more, rise from the base of a generally one-chambered ovary, or are borne on a free central placenta. This Order consists mainly of herbaceous plants : their flowers are mostly perfect and have a perianth of one or two whorls ; and in the latter case these may be similar or be differentiated into calyx and corolla, the parts being either in threes or fives. The stamens are very generally equal in number to the perianth-leaves and opposite to them ; but may be fewer or more numerous ; and the ovary is always superior. The ovules are bent in a horseshoe-like manner, the embryo they enclose sharing in this curvature and wrapping round the endosperm.

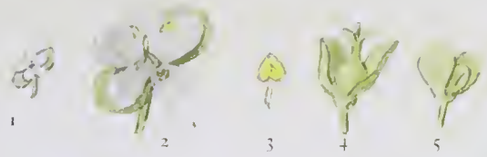
The Family *Portulacaceæ* has generally two sepals, imbricate in the bud, coherent at their bases, and persisting in the fruit stage ; five petals ; and three united carpels. The two genera by which the Family is represented in Britain, *Claytonia* and *Montia*, are closely related, both having an elastically explosive capsule which bursts into three valves and so discharges its three seeds. They differ in that *Claytonia* has its petals free with a stamen opposite each of them, whilst *Montia* has them united and unequal, with only three stamens, one opposite to each of the three smaller corolla-lobes.

Claytonia only is represented on this Plate. The first figure in the first row is a flower, natural size : the second shows the same enlarged : the third, a stamen : 4 is the fruit ; and 5, a longitudinal section through part of it.

The six other rows of figures all represent *Caryophyllaceæ*, the same characters of flower, fruit, and seed being generally shown in the same order in each case. The genera represented are *Alsine*, *Stellaria*, *Lychnis*, *Silene*, and *Dianthus ;* but two rows are devoted to *Lychnis*, *L. Githago* Scopoli, once put in a separate genus, being figured as well as *L. Flos-cuculi* Linné.

Alsine has five distinct sepals ; five entire petals ; and a three-valved, many-seeded capsule. Its leaves have membranous stipules. In the second row of figures on the Plate, 1 is an enlarged representation of a flower seen full face, as if from above ; 2 is the calyx and stamens ; 3, an unripe capsule, enlarged ; 4, a ripe capsule bursting ; and 5, a seed.

Stellaria, of which we had several species on one Plate, is characterised by five distinct sepals, five bifid petals, stamens generally ten in number, three styles, and six teeth to the many-seeded capsule. In this genus there are no stipules.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ANALYTICAL DRAWINGS OF THE PURSLANE AND PINK FAMILIES—continued.

In the third row of figures on our Plate, 1 shows a flower in longitudinal section; 2, the calyx; 3, a petal; 4, the stamens and gynæceum enlarged; 5, the capsule bursting; and 6, a seed.

Lychnis has no stipules, five sepals united, five petals each furnished with a claw, ten stamens, five styles, and generally five teeth to the capsule.

Lychnis Githago Scopoli is distinguished by the long leafy lobes of the calyx which are longer than the petals. The fourth row of figures on the Plate are taken from this species. Fig. 1 is the flower; 2, a sepal; 3, the stamens and gynæceum; 4, the gynæceum alone; 5, an unripe fruit with the calyx; 6, the same without the calyx; and 7, a cross section of the same.

The fifth row of figures represents *Lychnis Flos-cuculi* Linné, Fig. 1 being the flower as seen from above; 2, the calyx which has only short teeth; 3, one of the deeply four-cleft petals with a stamen; 4, the stamens and gynæceum; 5, the capsular fruit; and 6, the same as seen from above.

The genus *Silene* is in most of its species distinguished from *Lychnis* by having only three styles and six teeth to its capsule; but *Silene amœna* Hudson, the Sea Campion, which here represents the genus, is exceptional in agreeing with *Lychnis* in having five styles and five teeth. In the sixth row of figures, Fig. 1 is a flower; 2, a petal and stamen; 3, the stamens and gynæceum; 4, the gynæceum alone; 5, the same enlarged; 6, the calyx in the fruit stage; 7, the capsule seen within the calyx; and 8, the seeds.

Dianthus is distinguished by having two or more scales or bracts immediately below the calyx, two styles, and four teeth to the capsule. In the last row of figures on the Plate, Fig. 1 shows the calyx and bracts; 2, a flower in longitudinal section; 3, the stamens and gynæceum; 4, a cross section of the fruit; and 5, a longitudinal one.

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